ICESat (GLAS) Science Processing Software Document Series

Volume
GSAS Version Description
Version 5.0

Jeffrey Lee/SGT, Inc.
Cryospheric Sciences Branch
Hydrospheric and Biospheric Sciences Laboratory
NASA/GSFC Wallops Flight Facility

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ICESat Contacts:

H. Jay Zwally, ICESat Project Scientist
NASA Goddard Space Flight Center
Greenbelt, Maryland 20771

Bob E. Schutz, GLAS Science Team Leader
University of Texas Center for Space Research
Austin, Texas 78759-5321

David W. Hancock III, Science Software Development Leader
NASA/GSFC Wallops Flight Facility
Wallops Island, Virginia 23337

Foreword

This document contains the GLAS Science Algorithm Software (GSAS) Version Description document. This document is developed under the structure of the NASA STD-2100-91, a NASA standard defining a four-volume set of documents to cover an entire software life cycle. Under this standard a section of any volume may, if necessary, be rolled out to its own separate document. This document is a roll- out of the version description within the Product Specification Volume.

The GEOSCIENCE LASER ALTIMETER SYSTEM (GLAS) is a part of the EOS program. This laser altimetry mission will be carried on the spacecraft designated EOS ICESat (Ice, Cloud and Land Elevation Satellite). The GLAS laser is a frequency-doubled, cavity-pumped, solid state Nd:YAG laser.

This document was prepared by the Cryospheric Sciences Branch at NASA GSFC/WFF, Wallops Island, VA, in support of B. E. Schutz, GLAS Science Team Leader for the GLAS Investigation. This work was performed under the direction of David W. Hancock, III, who may be contacted at (757) 824-1238, David.W.Hancock@nasa.gov (e-mail), or (757) 824-1036 (FAX).

This document was created through the efforts of the GLAS Science Software Development Team. Current team members include:

SGT, Inc./Kristine Barbieri

SGT, Inc./Suneel Bhardwaj

SGT, Inc./Lisa Brittingham

SGT, Inc./John DiMarzio

614/David W. Hancock, III

SGT, Inc./Peggy Jester

SGT, Inc./Jeffrey Lee

SGT, Inc./Dennis Lockwood

SGT, Inc./Steve McLaughlin

SSAI/Steve Palm

SGT, Inc./Carol Purdy

SGT, Inc./Lee Anne Roberts

SGT, Inc./Jack Saba

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Section 1

Introduction

1.1 Identification of Document

This is the Version Description document for the Version 5.0 delivery of the GLAS Science Algorithm Software (GSAS). The unique document identification number within the GLAS Ground Data System numbering scheme is TBD. Successive editions of this document will be uniquely identified by the cover and page date marks.

1.2 Scope of Document

The GLAS I-SIPS Data Processing System, shown in Figure 1-1, provides data processing and mission support for the Geoscience Laser Altimeter System (GLAS). I-SIPS is composed of two major software components - the GLAS Science Algorithm Software (GSAS) and the Scheduling and Data Management System (SDMS). GSAS processes raw satellite data and creates EOS Level 1A/B and 2 data products. SDMS provides for scheduling of processing and the ingest, staging, archiving and cataloging of associated data files. This document is the Version Description for the GSAS Version 5.0 software delivery.

1.3 Purpose and Objectives of Document

The purpose of this document is to provide a precise description of the Version 5.0 delivery of GSAS.

1.4 Document Organization

This document's outline is assembled in a form similar to those presented in the NASA Software Engineering Program [Information Document 2.3a].

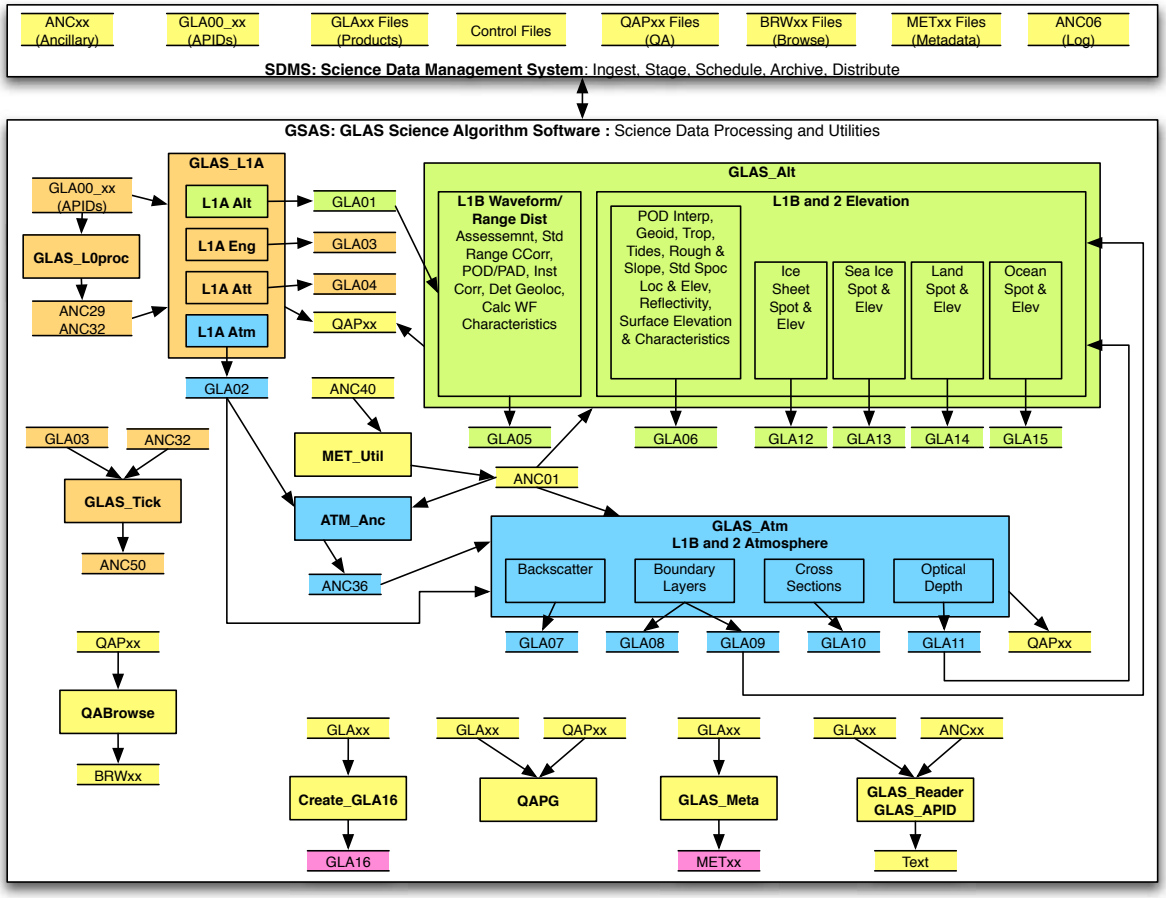

Figure 1-1 I-SIPS Software Top-Level Decomposition

1.5 Document Change History

Document Name: GLAS Science Algorithm Software Version Description		
Version Number	**Date**	**Nature of Change**
Version 0	July 1999	Original Version.
Version 1	November 2000	Revised for V1 software.
Version 2	November 2001	Revised for V2 software.
Version 2.2	July 2002	Revised for V2 software.
Version 3.0	October 2002	Revised for V3 software.
Version 4.0	August 2004	Revised for V4.0 software.
Version 5.0	December 2005	Revised for V5.0 software.

Section 2

Related Documentation

2.1 Parent Documents

Parent documents are those external, higher-level documents that contribute information to the scope and content of this document. The following GLAS documents are parent to this document.

a) *GLAS Science Software Management Plan* (GLAS SSMP), NASA/TM-1999-208641/Version 3/Volume 1, August 1998, NASA/GSFC Wallops Flight Facility.

The GLAS SSMP is the top-level Volume 1 (Management Plan Volume) document of the four volumes of NASA software engineering documentation [Applicable Reference 2.2c]. It dictates the creation and maintenance of the Product Specification Volume (Volume 2). This document is a roll out of the Product Specification Volume.

2.2 Applicable Documents

a) *NASA Software Documentation Standard Software Engineering Program*, NASA-STD-2100-91, July 29, 1991, NASA.

b) *GLAS Science Algorithm Software (GSAS) Detailed Design Document*, Version 5.0, October 2005, NASA/GSFC Wallops Flight Facility.

c) *GLAS Science Algorithm Software (GSAS) User's Guide*, Version 6.0, October 2005, NASA/GSFC Wallops Flight Facility

2.3 Information Documents

a) *GLAS Science Telemetry Packets Definition Document*, GLAS-582-SPEC-002/Revision E, June 2005, NASA Goddard Space Flight Center.

b) *GLAS Standard Data Products Specification - Level 1*, Version 8.0, October 2005, NASA/GSFC Wallops Flight Facility.

c) *GLAS Standard Data Products Specification - Level 2*, Version 8.0, October 2005, NASA/GSFC Wallops Flight Facility.

d) *GLAS Science Data Management Plan* (GLAS SDMP), NASA/TM-1999-208641/Version 4/Volume 2, July 1999, NASA/GSFC Wallops Flight Facility.

e) *Derivation of Range and Range Distributions From Laser Pulse Waveform Analysis for Surface Elevations, Roughness, Slope, and Vegetation Heights*, Algorithm Theoretical Basis Document, Version 4.3, August 2004, NASA GSFC, et. al.

f) *Precision Orbit Determination (POD),* Algorithm Theoretical Basis Document, Version 2.2, October 2002, Center for Space Research, The University of Texas at Austin.

g) *Precision Attitude Determination (PAD)*, Algorithm Theoretical Basis Document, Version 2.2, October 2002, Center for Space Research, The University of Texas at Austin.

h) *Atmospheric Delay Correction to GLAS Laser Altimeter Ranges*, Algorithm Theoretical Basis Document, February 1999, Massachusetts Institute of Technology.

i) *Ocean Tidal Loading Corrections*, Version 1.0, February 1999, NASA Goddard Space Flight Center, et al

j) *Laser Footprint Location (Geolocation) and Surface Profiles*, Version 3.0, October 2002, NASA Goddard Space Flight Center, et al

k) *Atmospheric Data Products*, Version 4.2, June 2001, NASA Goddard Space Flight Center, et al

l) *The Algorithm Theoretical Basis Document for Level 1A Processing*, Version 1.6, June 2005, NASA GSFC/Wallops Flight Facility.

Section 3

Product Description

3.1 Purpose

GSAS generates the GLAS Standard Data Products and associated metadata describing the products and their quality. The software uses GLAS telemetry and ancillary data to produce the products using algorithms defined by the GLAS Science Team.

GSAS is delivered as a set of libraries and executables (PGEs). The design and structure of GSAS is fully described in the GSAS Detailed Design Document.

Throughout this document, files are referenced as one of two types: GLA or ANC. GLA files are integer-binary format product files containing Level 0-2 GLAS science data. The GLA files are fixed-length binary files containing scientific measurements. GLA files are both input and output to GSAS. ANC files are multi-format ancillary files supplied by the science team which are required for processing. These files are detailed in the GLAS Data Management Plan and GLAS Standard Data Product Specifications Documents.

3.2 Environment

GSAS software is developed for and delivered on the UNIX platform. This document assumes that the reader is familiar with UNIX operating system conventions. The software is currently supported on the HP/UX 11.0 operating system with Fortran 90 version v2.5.

3.3 Functions

The GSAS functions for V5.0 are:

- Read GLAS telemetry data and standard data products and ancillary files. Provide time-synchronization between product and ancillary files and between multiple products.
- Create all standard data products in an integer-binary format. These data products are grouped into the following categories:
  - Level-1A products. (GLA01-04)
  - Waveform products. (GLA05)
  - Atmosphere products. (GLA07-11)
  - Elevation products. (GLA06, GLA12-15)
- Perform selective processing based on input and output defined in a user-supplied control file.
- Creates EOS inventory metadata files.

- Maintain a full processing history.
- Report errors and messages in a standardized fashion with user-defined options available.
- Read changeable parameters from Science Team-supplied ancillary files.
- Convert product data into human-readable output.
- Create scientifically accurate data products.

3.4 Restrictions and Limitations

The V5.0 delivery of the GSAS has the following limitations:

- The software has the capability of processing many different scenarios. However, only fully-tested scenarios are supported. These scenarios are:
  - One processing string to create all L1A products (GLA00 to GLA01-04).
  - One processing string that starts with an L1A altimetry product (GLA01) input to produce a waveform product (GLA05).
  - One processing string that starts with a waveform product (GLA05) input (and optionally GLA09 and GLA11) to produce all elevation products (GLA06, 12,13,14,15). (If no GLA09/GLA11, some atmosphere data will be invalid)
  - One processing string that starts with L1A atmosphere (GLA02) input and produces L2 atmosphere products (GLA07,08,09,10,11).
  - One processing string that starts with L1B atmosphere (GLA07) input and produces L2B atmosphere products (GLA08,09,10,11).
- Not all utility PGEs conform with GSAS standards regarding control files, file naming, error reporting, and processing history.
- GSAS core and utility PGEs may be run without error if all ANC07 files are specified within the control file. Only specific ANC07 files are required for each PGE, but we have verified that specifying all does not cause an error. This capability was verified in order to avoid a potential SDMS limitation.
- More improvements to the atmosphere and elevation processing algorithms are expected.
- GSAS will **not overwrite** existing files.The software will halt with a fatal error unless old output files are removed before execution.
- The GSAS is supported on HP/UX 11.0 with HP Fortran 90 compiler version 2.5.
- This documentation is limited to GSAS and thus will not describe procedures or utilities within the scope of SDMS.

Section 4

Inventory and Product

4.1 Materials Released

Materials released include software code, documentation, static ancillary data and test data. These materials may be delivered either electronically or on physical media. The deliver will be broken into multiple tarfiles in order that individual files sizes not exceed 2 GB. The documentation is delivered electronically in the form of Adobe PDF (Portable Document Format) files and, by request, hardcopy.

Tarfiles delivered electronically have the following content:

part_1.tar : GSAS source code, data and docs
untars into gsas_v5.0_dap/

part_2.tar : verification test and data
untars into gsas_v5.0_dap/test

part_3.tar : standalone f90 and IDL readers
untars into gsas_v5.0_dap/scf_readers and gsas_v5.0_dap/idl_readers

README.txt files are provided in the root level of part_1.tar, in gsas_v5.0_dap, and in gsas_v5.0_dap/scf_readers.

4.2 Product Content

To extract the GSAS Version 5.0 software, change to an appropriate directory (suggested at least 6 GB available on the disk) and use the tar command to extract the software from the distribution tarfiles.

When the tarfiles are extracted, a gsas_v5.0_dap directory and several sub-directories will be created. Table 4-1 lists the top-level subdirectories.

Table 4-1 Top-level Content

Item	Description
README.txt	Detailed inventory file.
data	Delivered ancillary data.
docs	Documentation in PDF format.
gsas	Link to version specific GSAS directory.
gsas_v5.0	GSAS directory.
idl_readers	Sample SCF-provided IDL reader code.
scf_readers	Sample SCF-provided f90 reader code.
test	Verification testing area.

4.2.1 Data (/data)

The data directory contains static ancillary files necessary to run GSAS. Some of these files may be symbolic links into the gsas/data directory. Non-linked data files are listed in Table 4-2

Table 4-2 data Content

Filename	File Type
ANC33_001_20050915_000000_01_0000.DAT	GLAS ISF/GLAS ISIPS Interface file
anc12_004_01_0000.dat	Coarse-resolution Digital Elevation Model.
anc12_004_01_0001.dat	Fine-resolution Digital Elevation Model.
anc13_004_01_0000.dat	Geoid.
anc16_001_01_0000.dat	Load Tide Coefficients.
anc17_001_01_0000.dat	Ocean Tide Coefficients
anc18_001_01_0000.dat	Standard Atmosphere File.
anc25_001_20021213_000000_01_0000.dat	GPS-UTC Conversion File.
anc27_001_01_0000.dat	Fine-resolution regional mask.
anc27_001_01_0001.dat	Coarse-resolution regional mask.
anc30_001_01_0000.dat	Global aerosol categorization map.
anc31_001_01_0000.dat	Aerosol tropospheric classification map.
anc35_001_01_0000.dat	Ozone file.
anc38_001_01_0000.dat	Multiple-scattering table.
anc41_009_01_0000.dat	JPL Planetary Ephemeris File.
anc52_001_01_0001.dat	Saturation Correction Table-range
anc52_001_01_0002.dat	Saturation Correction Table-energy
anc52_001_01_0003.dat	Saturation Correction Table-pulse width

4.2.2 Documentation (/docs)

The required delivery documentation for Version 5.0 is found in the docs directory. These documents are listed in Table 4-3

4.2.3 GSAS Directory (/gsas)

The GSAS directory contains the structure and content needed for GSAS to compile and run. Table 4-4 lists the content of the gsas_v5.0 directory.

The bin and lib directories are delivered without content. They will be populated during the installation process. The remainder of this subsection describes content of the other directories.

Table 4-3 docs Content

Item	Description
atbd_waveform.pdf	ATBD - Derivation of Range and Range Distributions From Laser Pulse Waveform Analysis for Surface Elevations, Roughness, Slope, and Vegetation Heights
atbd_pod.pdf	ATBD - Precision Orbit Determination (POD)
atbd_pad.pdf	ATBD - Precision Attitude Determination (PAD)
atbd_tropo.pdf	ATBD - Atmospheric Delay Correction to GLAS Laser Altimeter Ranges
atbd_tide.pdf	ATBD - Ocean Tidal Loading Corrections
atbd_geolocation.pdf	ATBD - Laser Footprint Location (Geolocation) and Surface Profiles
atbd_atmos.pdf	ATBD - Atmospheric Data Products
atbd_l1a.pdf	ATBD - Level 1A Processing
gsas_ddesign.pdf	GSAS Detailed Design Document.
gsas_user_guide.pdf	GSAS User's Guide.
gsas_ver_desc.pdf	GSAS Version Description (this document).
glas_prod_spec_1.pdf	GLAS Standard Data Product Spec - Level 1
glas_prod_spec_2.pdf	GLAS Standard Data Product Spec - Level 2
glas_smp_v2.pdf	GLAS Science Software Management Plan
glas_dmp_v2.pdf	GLAS Data Management Plan

Table 4-4 GSAS Content

Item	Description
bin	Directory where executables are stored.
cc_util	Make utilities.
data	Science-team provided static-ancillary files.
lib	Directory where shared libraries are stored.
Makefile	Distribution Makefile.
src	Source code.

4.2.3.1 Makefile utilities (/gsas/cc_util)

This directory contains GSAS-standard makefile utilities. These files are used in GSAS makefiles and can be modified to change such things as compile-time options in a consistent manner.

Table 4-5 cc_util Content

Item	Description
cc_make_final.sh	Clearcase glue script to ease installation.
make_defs.	Symbolic link to make_defs.hp
make_defs.hp	HP-specific Makefile definitions.
make_defs.sun5	Sun-specific Makefile definitions.
make_defs.incl	Generic Makefile definitions.
make_depends.incl	Makefile dependencies.

4.2.3.2 Ancillary Data (/gsas/data)

Initial versions of the science-team supplied ancillary data files are included in this release. These files are located in the data directory of the tarfile and reflect the latest versions in operational use.

Table 4-6 data Content

Item	Description
anc07_001_00_00.dat	Error and Status file. Generated by development team.
anc07_001_00_01.dat	Global constants file. Generated by development team.
anc07_001_00_02.dat	Atmosphere constants file. Generated by development team.
anc07_001_00_03.dat	Elevation constants file. Generated by development team.
anc07_001_00_04.dat	Waveform constants file. Generated by development team.
anc07_001_00_05.dat	L1A constants file. Generated by development team.
anc07_001_00_06.dat	Utility constants file. Generated by development team.
anc45_*.dat	Product Metadata Template File. Produced for each product type by the development team.
anc46_*.dat	Ancillary Metadata Template File. Produced for each supported ANC type by the development team.

4.2.3.3 Source (/gsas/src)

Contents of the src directory are described in detail within the GSAS Detailed Design Document. Table 4-7 lists each major subdirectory.

Table 4-7 src Content

Item	Description
atmosphere	Development code for atmosphere code.
atm_anc	Atmosphere Utility

Table 4-7 src Content (Continued)

Item	Description
atm_lib	Links atmosphere code into library structure.
common_libs/anc_lib	Development directory for anc_lib.
common_libs/cntrl_lib	Development directory for cntrl_lib.
common_libs/err_lib	Development directory for err_lib.
common_libs/file_libt	Development directory for file_libt.
common_libs/geo_libt	Development directory for geo_libt.
common_libs/math_lib	Development directory for math_lib.
common_libs/platform_lib	Development directory for platform_lib.
common_libs/prod_lib	Development directory for prod_lib.
common_libs/time_lib	Development directory for time_lib.
createGran_util	Granule Utility
create_dem	DEM Utility
create_gla16	GLAS L3 PGE (unused)
dem2vis	GLAS Visualizer DEM utility.
elevations	Development code for elevations code.
elev_lib	Links elevation code into library structure.
glas_alt	GLAS Altimetry PGE
glas_apid	L0 Reader Utility
glas_atm	GLAS Atmosphere PGE
glas_gps	GLAS GPS processor (unused)
glas_l0p	GLAS L0 PGE
glas_l1a	GLAS L1A PGE
glas_meta	GLAS Metadata processor
glas_reader	GLAS Reader Utility
glas_tick	GLAS Utility PGE.
l1a_lib	Development directory for L1A code
lib	Development shared library directory. (initially empty)
Makefile	Master source Makefile
met_util	Met file Utility
modules	Development module directory. (initially empty.)

Table 4-7 src Content (Continued)

Item	Description
NOSE_util	NOSE utility
prod_util	Misc product utilities
qapg	QA PGE.
reforbit_util	Reference Orbit Utility
track_reader	unused.
wf_lib	Development directory for waveforms code.

4.2.3.4 IDL (/gsas/idl)

The IDL directory contains IDL programs and libraries used by the Browse and QAP software.

4.2.4 IDL Product Readers (/idl_readers)

The IDL product readers directory contains sample IDL product reader software contributed by the SCF.

4.2.5 SCF Product Readers (/scf_readers)

The SCF product readers directory contains sample F90 product reader software contributed by the SCF. This software does not require the GSAS standard libraries.

4.2.6 Testing and Sample Products (/test)

The V5.0 delivery version contains, within the test directory, test data and facilities for use in validating correct operation of the delivered software. The content and usage of the test directory is documented in the GSAS Acceptance Test Procedures Document.

Section 5

Change Status

The Version 5.0 delivery of GSAS contains major changes from Version 4. The most important changes are updated product formats, code additions and corrections to reflect updated ATBDs and new functionality provided by additional PGEs.

5.1 Installed Changes

5.1.1 Science Algorithms

Implemented changes defined in the latest version of the science algorithm ATBDs. These changes are documented in each respective ATBD. The latest ATBDs are available at:

http://www.csr.utexas.edu/glas/atbd.html

and

http://glas.wff.nasa.gov

The versions implemented in the V5.0 delivery are included as PDF files in the 'docs' directory of this distribution. The following table lists the version of each ATBD used for V5.0 development.

Table 5-1 ATBD Versions Implemented in V5.0

Title	Version
Derivation of Range and Range Distributions From Laser Pulse Waveform Analysis for Surface Elevations, Roughness, Slope, and Vegetation Heights	September 2003
Precision Orbit Determination (POD)	October 2002
Precision Attitude Determination (PAD)	October 2002
Atmospheric Delay Correction to GLAS Laser Altimeter Ranges	March 2001
Ocean Tidal Loading Corrections	August 1999
Laser Footprint Location (Geolocation) and Surface Profiles	October 2002
Atmospheric Data Products	October 2002
The Algorithm Theoretical Basis Document for Level 1A Processing	July 2005

5.1.2 Data Products

Version 5.0 of the data products were implemented as described in the GLAS Standard Data Product Specifications - Level 1 and 2 and the respective ATBDs. Most significantly, this release added new parameters to most L2 products, requiring a record size increase.The new record sizes are listed in Table 5-2:

Table 5-2 Record Size Changes

Product Type	Record Size (bytes)
GLA06	6880
GLA11	3032
GLA12	6600
GLA13	6760
GLA14	10000
GLA15	6280
GLA05	17400
GLA07	70456
GLA08	792
GLA09	6944
GLA10	14976

The complete content and description of the as-implemented Level 0, Level 1 and 2 products are available at http://glas.wff.nasa.gov.

5.1.3 Change Summary

This section hilights the major changes between GSAS v4.0 and GSAS v5.0.

5.1.3.1 GLAS_L0proc

- Several error checks were added to GLAS_L0proc to improve detection of GPS resets and counter rollovers.

5.1.3.2 GLAS_L1A

- Implemented a 1-shot gain shift algorithm which should improve energy-related parameters.
- Implemented sanity checking algorithm which flags ANC32 files that do not contain valid GSP latches.
- Changed spare bits from 1 to 0 in the Instrument State flag.
- Implemented enhancements and fixes to the energy computations.
- A correction was made to the EU conversion of GLA04 IST i_VTBoreH and i_VTBoreV.

5.1.3.3 GLAS_Atm

- Added along-track QA and browse capabilities for atmosphere products.
- Added surface type flag to atmosphere products.

- Improved aerosol/cloud discrimination and layer detection.
- Added control file sanity checking.
- 532 cloud layer detection improved. Changes made result in the 40 Hz cloud search being executed for every shot, independent of the results of cloud searches at lower resolutions. Also the starting height for the cloud search is now 10 km, which means that clouds will now be reported when found up to the 10 km altitude (in prior versions, 4 km was the maximum). These changes mean that a cloud could be reported for one or more 40 Hz shots of a given second, while no cloud was reported at the 1 second or 5 Hz resolution.
- Through ISIPS release 23, cloud detection using the GLAS 1064 nm atmospheric channel was limited to 4 and 1 second resolution. This was due mainly to the low inherent signal to noise of the 1064 data. Over the last 6 months or so, we have been striving to produce 1064 cloud top height on a shot to shot basis (40 Hz). The new algorithms have been tested and are included in this release of GSAS. The limited amount of testing done to date has shown that we can definitely detect clouds at this resolution, though the exact limits of what can be detected (in terms of optical depth) have not yet been quantified. An assessment will be performed after the laser 2a data has been reprocessed using this release of the GSAS software by comparing the 1064nm cloud detection with that of the 532nm channel. A part of the cloud detection algorithm is based on the integrated 1064 nm signal, which is also stored as a separate quantity on the release 24 GLA09 product. Testing has shown that when the magnitude of the integrated signal exceeds a certain threshold, it is highly likely (as corroborated by the 532 channel) that there is a cloud present even if the thresholding algorithm did not detect a cloud. In this case, the cloud height is set to 10 km and a flag is set to indicate this fact. The algorithm also interrogates the ground return signal width in an effort to detect very low clouds. Over flat terrain like the ice sheets, the 1064 ground return signal has a characteristic width. When this signal is unusually wide, and clouds have not been detected higher up, the cloud top height is set to 100 m and a flag is set to indicate the likely presence of low clouds. While these approaches improve the overall cloud detection, they too have their limits. We'll have to wait until we can perform extensive testing to determine what those limits are.

5.1.3.4 GLAS_Alt Waveforms

- Improved alternate fit for a specific case of waveforms.
- Added new LPA orientation parameters to waveform and elevation products.
- Restructured the Waveform Manager.
- Improved energy/reflectance calculations.
- Added Saturation Index.
- Significantly improved waveform alternate fitting process. The changes make the process more compliant with the ATBD and significantly improve processing time. The changes are detailed in the next three bullets:

- Alternate fit uses the normalized waveform based on area before functional fit. (Standard fit uses raw voltage waveform).
- Alternate fit uses up to 5 largest peak plus peak nearest ground. The algorithm keeps all 6 peaks but amplitudes are allowed go to zero.
- Alternate fit least square exit criteria changed. Maximum iterations are now significantly less frequent. In fact, if maximum iteration flag is set, data should not be used (or used with caution).
- Changes have been made to both the transmit and received energy calculations as suggested by the instrument team. For details of the energy computation see the waveform ATBD.
- Two minor changes have been made to the standard parameterization waveform fitting. The standard fit now uses the absolute peak location change instead of a percentage change as the convergence criteria in the gaussian fitting. An error in the computation of the standard fit sigma has also been corrected. Neither of these changes has significantly affected the elevations on the data.
- In the alternate waveform fitting, an option to normalize the waveform based on the peak amplitude was implemented. An error in reporting the alternate fit standard deviation was corrected and the precision was changed on the product to accommodate the smaller numbers. The alternate fit parameters were changed to perform normalization by peak amplitude before fitting, the minimum distance between selected peaks was set to be greater than 15 ns, and the weight of the sigma widths was tuned to provide the best alternate fits on selected land waveforms.

5.1.3.5 GLAS_Alt Elevations

- Improved calculation of sea ice roughness parameters and added new sea ice parameters to elevation products.
- Fixed a a data synchronization issue that occurs when GLA09/11 are input to elevation processing which caused the ANC09 data to be unavailable for a large percentage of the time.
- Fixed an unrelated problem where a large number of instrument state changes caused an array overflow error.
- Restructured the Elevation Manager.
- Fixed synchronization problem caused by atmosphere data input.
- Added the following parameters to the elevation products:
  - A high-resolution DEM value from the SRTM V2 90m resolution DEM for latitudes between 60N and 60S
  - Gain and received energy placed on all of the level 1b and 2 products.
  - Surface pressure, temperature, and relative humidity on all level 2 products

- Saturation range correction for low gain (13 counts) returns.
- 1064nm cloud top and integrated signal from the lidar team (40Hz)

5.1.3.6 General

- Made significant improvements to QA processing and browse products.
- Improved product database documentation.
- General code cleanup.

5.1.4 Implemented PR/CRs

The software development team uses Change Requests (CR) and Problem Reports (PR) to identify problems in the software.Table 5-3 lists those PR/CRs addressed from GSAS 4.0 to GSAS 5.0.

Table 5-3 PR/CRs Addressed in Version 5.0

PR/CR	Short Description
0000371	dry trope correction has blips
0000617	GLA13 QA problem regarding Sea Ice roughness
0000839	Release 12 GLA05 problems discovered in QA data
0001005	Modify QAPG to Work with Changed QAP03_mod.
0001267	GLA09 Aerosol / Cloud Discrimination and Layer Detection
0001273	No valid QA for GLA08-11
0001386	QAP01 changes for Metadata
0001387	QAP02 change for Metadata
0001388	QAP03 change for metadata
0001389	QAP04 changes for metadata
0001390	Elevation QAP changes for metadata
0001399	Version number for QAPRead
0001402	Waveform ATBD change needed
0001403	Merge QAPxx modules with elevation code
0001414	Parameter name duplication in QAP02 and QAP06
0001616	GLAS_ATM options sanity checks
0001625	GLA05 browse products - locations reported on along-track scatter plots incorrect
0001628	Gain reported is delayed in application
0001634	Land/Ocean Flag added to Atmosphere Products
0001657	Add LPA orientation parameters to GLA05

Table 5-3 PR/CRs Addressed in Version 5.0

PR/CR	Short Description
0001666	QAPG should get requested file times from control file
0001667	QAPG changes for metadata requirements
0001668	Sea ice roughness parameters not calculated correctly on GLA13
0001670	Problems with waveform QA
0001672	QAPCompare, QAPRead changes for GLA01 and GLA05 metadata
0001674	GLA04 LPA, LRS image descriptions need clarification/correction
0001678	GLAS ATM bombs with integer overflow in gla07_scal_mod
0001681	GLA01 i_inststate spare bits are set but not documented as such
0001696	All Browse 05 jobs are failing (Rel 18)
0001699	Implement Along-track averaging QA for GLA7-11
0001707	Short anc32 File Sanity
0001708	Change to 40 Hz cloud layer height generation
0001713	Improve Alternate Fit of Some WFs
0001726	QAP01 % APID 12/13 calculated incorrectly
0001731	i_rng_UQF (GLA06,12-15) online documentation not consistent with code
0001737	Software Problem Report
0001750	Laser xmit and received energy calculation incorrect
0001758	Change QAPG to use new qapxx_mod for GLA 7-11
0001759	Modify IDL software to work with updated qap files for GLA 7-11
0001761	GLA06/12-15 Variable i_reflCor_atm Mislabeled
0001763	Replace estimated atm. trans. with actual in reflectivity calculation
0001765	Optical Density units GLA11
0001766	Change metadata contact info
0001767	Update metadata VersionID, VersionDescription
0001769	bad last record in GLA01
0001771	Overflow condition in GLA10_scal_mod
0001779	IDL QA issues
0001780	GLA06 and GLA05 metadata file does not have the same number of instrument states
0001781	ESDTs Rel 19 instrument state

Table 5-3 PR/CRs Addressed in Version 5.0

PR/CR	Short Description
0001783	Waveforms crashes in anc08 module
0001794	Crash in GLA06 A2P for bad d_SigEndOff
0001797	MSWF documentation needs details
0001798	40 Hz Cloud Heights from the 1064 Channel
0001806	Tweak to Cloud/Aerosol Discrimination
0001810	The Documentation For GLA05 Needs To Be Changed
0001814	Energy Computation Is Wrong For Compressed WFs
0001815	GLAS_Atm overflow for QAP09
0001816	QAP03 browse jobs fail
0001820	Problem generating QAP07 files for multi-file run
0001822	Rel. 19 polar projection plots too large on browse products
0001830	GLA14%d_Gamp and GLA14%d_Gsigma Not Set
0001836	IDL QA color table path problem
0001839	Noisy WFs have Bad Alternate Fits
0001841	Bad QAP12 file
0001848	V4.1 product database incorrect
0001853	GLAS_Alt manager cleanup
0001854	Update IDL code to work with changed GLA02 QAP files
0001858	Add saturation index to GLA05
0001862	i_beam_azimuth definition change
0001863	GLA06 i_MRC_af description
0001868	Incorporate SRTM DEM Data into GSAS Software
0001871	QAP04 difference between L1a and QAPG
0001874	V4.1 database wrong for d_SiRufMaxPk on GLA13
0001876	units for i_RMSpulseWd wrong on V4.1 database for GLA05
0001878	i_FrameQF database entry for GLA06 vs. other products
0001882	clarify description Bit 3 i_SiRufQF
0001902	GLA06 uses GLA05 PAD when GLA09/11 inputs specified.
0001903	WFMgr Calculating Energy With Wrong Instrument State
0001904	Duplicated Code In WFMgr & L_EngCorr

Table 5-3 PR/CRs Addressed in Version 5.0

PR/CR	Short Description
0001905	WFMgr does not re-initialize QA start time for new granule
0001910	WF QA does not write summary record in a specific case.
0001913	Elev mgr crashes on integration branch
0001919	Need to change method used to get aux. info to the IDL code
0001922	GLA01 waveform reader
0001923	Bug in ErrorInit_mod.f90
0001924	Add sanity check override flag to PGEs
0001926	Update QABrowse and read s/w for changes to QAP03
0001927	Add IDL VM version of QA print utility
0001930	IDL Portion of 0001922
001931	QAP03 Use of Non-science vs Science Limits for Engineering Values
0001932	Modify QAPCompare to generate valid GLA03 metadata
0001939	Product Record Size Change
0001945	Alternate Waveform Fit converge exit test and peak combine changes
0001946	Incorrect Calculation of QAP04 Metadata Statistics
0001950	GLA07 Product Units
0001953	i_OrbFlg disconnected among products in database
0001959	Patch WF code for acctest
0001962	QAP version number is wrong
0001966	VersionID for GSAS 4.3
0001967	Error while generating GLA04 browse products
0001970	Energy quality flags disconnected between products in database
0001971	Received Energy is not being Computed in GSAS 4.3
0001972	Force energy computation for GSAS v4.3
0001976	Error during Comparison of QAP04 Files
0001978	Add QAP Version Number Override.
0001980	GLA07 il_g_bscs_qf Definition Needs Updating in Database
0001985	V4.3 i_CorrStatFlg(3) Definitions need Improvement in Database
0001992	GLA15 Elevation Wrong
0001993	WFQual Select Region Flags Descriptions are Unclear

Table 5-3 PR/CRs Addressed in Version 5.0

PR/CR	Short Description
0002013	QABrowse Error for GLA10
0002015	Old Unused Modules Should be Removed from Waveforms Directory
0002019	Update anc45 VersionID 23
0002022	GLA09 Data Product Scaling Factor Documentation Error
0002023	Update L1A ATBD
0002025	Addition of Meteorology Data to GLA08-11
0002027	i_AttFlg1 Incorrectly Defined
0002029	GLA11 Quality and Use Flags
0002033	Add New Variable to GLA06 and Higher Elevation Products
0002034	Waveform Fit Standard Method Location /Convergence Change
0002036	atmQF Flag Not Reset Dynamically
0002042	Add Energy and Received Gain to Higher Level Altimeter Products
0002045	Error in QAP Headers for Files Written by QAPG
0002048	Coordinate GSAS 5.0 Product Structure Changes
0002049	QAPCompare Formatted Out Error
0002050	GLA09 Med Res (1 Hz) Quality Flags are Weird
0002055	Incomplete Documentation for Lidar Flags
0002056	Change d_ThrNSigR
0002062	Undefined cloud layer quality flags in GLA09
0002074	The High Gain Saturation Flag in GLA05%l_WFqual Might not be Set Correctly
0002075	i_SigmaElv is Incorrect on GLA06
0002076	i_elvflg and i_SurfRuf_slpQF are Inconsistent between GLA06 and GLA14
0002078	Alternate Fit Anc07 Constant Change
0002079	Add 40Hz Lidar Cloud Information from GLA09,11 to GLA06/12-15
0002080	Unit Test Product Modifications
0002081	Error in GLA05_scal_mod.f90
0002082	Error in GLA08_alg_mod.f90
0002083	i_LRCir_af, i_MRCir_af in GLA09_alg_mod.f90?
0002084	i_MRir_QAflag Error in GLA11_alg_mod.f90

Table 5-3 PR/CRs Addressed in Version 5.0

PR/CR	Short Description
0002085	HiRes DEM Crash
0002086	Flags in GLA09_alg_mod.f90 Initialized as Invalid
0002090	Update Product Code from Tested Non-vob Code
0002091	Change Scale of d_wfFitSDev
0002097	Error in CalcSum Corrs Logic
0002100	ANC45/46 Need Update for GSAS 5.0
0002103	inconsistent beam colelev and azimuth
0002105	Update GSAS scf_prod_reader subroutines to support 5.0 formats
0002108	GLA07 variables in Product Database
0002109	IEEE Overflow in Atmosphere Optical Properties
0002111	Normalize WF Fits With Peak Amplitude
0002113	Saturation range correction not passed through from GLA06 to GLA12-15
0002117	Flags not assigned in GLA*scal_mod.f90
0002119	GLA04 IST Boresight scale error
0002128	D_WT_SGM should be changed to D_WT_SGM1 and D_WT_SGM2

5.2 Possible Problems and Known Errors

Table 5-4 lists the PRs and CRs open for V5.0. These will be corrected or mitigated in later releases.

Table 5-4 Open or Suspended PR/CRs for Version 5.0

PR/CR	Short Description
0001674	GLA04 LPA, LRS Image Descriptions Need Clarification/Correction
0001672	QAPCompare, QAPRead Changes for GLA05 Metadata
0001670	Problems with Waveform QA
0001668	Sea Ice Roughness Parameters not Calculated Correctly on GLA13
0001667	QAPG Changes for Metadata Requirements
0001666	QAPG Should get Requested File Times from Control File
0001662	Bad Data in GLA01 When Laser not Operating
0001657	Add LPA Orientation Parameters to GLA05
0001634	Land/Ocean Flag added to Atmosphere Products

Table 5-4 Open or Suspended PR/CRs for Version 5.0 (Continued) (Continued)

PR/CR	Short Description
0001631	Revise Documentation for GSAS 4.0 Delivery
0001628	Gain Reported is Delayed in Application
0001625	GLA05 Browse Products: Locations Reported on Along-Track Scatter Plots Incorrect
0001616	GLAS_ATM options sanity checks
0001496	Investigate Area Fit Of Saturated Waveforms
0001472	Atmosphere - 532 Background Problem
0001440	Investigate Differences between Waveforms QAP File and QAPG Output
0001414	Parameter Name Duplication in QAP02 and QAP06
0001403	Merge QAPxx Modules with Elevation Code
0001402	Waveform ATBD Change Needed
0001399	Version Number for QAPRead
0001390	Elevation QAP Changes for Metadata
0001389	QAP04 Changes for Metadata
0001388	QAP03 Change for Metadata
0001387	QAP02 Change for Metadata
0001386	QAP01 changes for Metadata
0001273	No valid QA for GLA08-11
0001267	GLA09 Aerosol / Cloud Discrimination and Layer Detection
0001245	Incorporate SRTM High-Definition DEM into GSAS Software
0001192	Atmosphere Browse Images
0001005	Modify QAPG to Work with Changed QAP03_mod.
0000976	GLA12-15 d_sigmaElv not set
0000934	Attempt to Reduce Memory Requirements of GSAS.
0000898	QAP04: LRS First Valid Star Image Sometimes not Valid
0000839	Release 12 GLA05 Problems Discovered in QA Data
0000647	QAP: Change in Requirement for Along-Track Times
0000617	GLA13 QA Problem Regarding Sea Ice Roughness
0000520	Data Quality Flags Needed in Metadata
0000519	Inconsistent/incorrect Determination of End of QAP Averaging Period: GLA06,12-15

Table 5-4 Open or Suspended PR/CRs for Version 5.0 (Continued) (Continued)

PR/CR	Short Description
0000470	Completion of Transmit Quality Flag Testing
0000459	GLA01 Format Description in Error in GLAS Standard Data Products- Level 1
0000428	Check Out Use of Measurements when Delay Line Pulse is Used
0000371	Dry Trope Correction has Blips
0000230	The ATM Level 2 Processing Does not Properly Handle a Large Time Gap
0000226	Guidelines for Special Processing of Saturated WF's have not been Supplied
0000108	Wrong KIND Types for Logicals in Many Modules
0000103	Update the GLAS Science Computing Facility Plan
0000099	Create Draft I-SIPS Training Requirements Guide
0000093	Review Product Descriptions for Atmosphere Products
0000080	New Utility to Create Time Correlation File with No GPS

5.3 Change Notes

The following are detailed change notes distributed for the interim versions of GSAS released since V4.0.

5.3.1 GSAS 4.1 Release Notes

Introduction

GSAS Release 4.1 introduces significant improvements in the software. 45 PR/CRs were resolved by this release.

For L1A, the following changes were made:

- Implemented a 1-shot gain shift algorithm which should improve energy-related parameters.
- Implemented sanity checking algorithm which flags ANC32 files that do not contain valid GSP latches.
- Changed spare bits from 1 to 0 in the Instrument State flag.
- Fixed multiple problems involving the energy computation.

For Waveforms, the following changes were made:

- Improved alternate fit for a specific case of waveforms.
- Added new LPA orientation parameters to waveform and elevation products.

For Elevation, the following changes were made:

- Improved calculation of sea ice roughness parameters and added new sea ice parameters to elevation products.

For Atmosphere, the following changes were made:

- Added along-track QA and browse capabilities for atmosphere products.
- Added surface type flag to atmosphere products.
- Improved aerosol/cloud discrimination and layer detection.

Other, more general fixes include:

- Updated ANC45 versionID and parameter names.
- Removed Instrument State parameters from metadata.
- Continued general code cleanup.
- Made significant improvements to QA processing and browse products.
- Improved product database documentation.
- Added additional parameters to products (see product change section for details).

Please refer to the attached documents "Revised Alternate Waveform Fitting Release Notes for Release 19" and "Level 2 Sea Ice Product - GLA13" for more specific changes regarding relevant improvements in this release.

Product Format/Definition Change Summary

GLA01-04:

i_GainShiftFlg : added to GLA01, partially replacing spare2.

i_inst_state : spares changed from 1 to 0 (reflects throughout rest of products).

i_boxX : updated description on GLA04_01.

i_boxY : updated description on GLA04_01.

i_PixInt : updated description on GLA04_01.

i_T0_SA : updated description on GLA04_02.

i_lrs_RawRow : updated description on GLA04_02.

i_lrs_RawCol : updated description on GLA04_02.

i_VTCentR : updated description on GLA04_02.

i_VTCentC : updated description on GLA04_02.

GLA05:

i_parm1 : changed units to 0.0001 volts, 6*(0.0001 volts, 0.01 ns, 0.01 ns)

i_parm1 : changed min values to -30, 6*(0, -100000, 0)

i_parm1 : changed max values to 30000, 6*(30000, 0, 32766)

i_parm2 : changed units to 0.0001 volts, 6*(0.0001 volts, 0.01 ns, 0.01 ns)

i_parm2 : changed min values to -30, 6*(0, -100000, 0)

i_parm2 : changed max values to 30000, 6*(30000, 0, 32766)

i_solnSigmas1 : changed units to 0.0001 volts, 6*(0.0001 volts, 0.001 ns, 0.001 ns); max values to 30000, 6*(30000, 3000, 3000).

i_solnSigmas2 : changed units to 0.0001 volts, 6*(0.0001 volts, 0.001 ns, 0.001 ns); max values to 30000, 6*(30000, 3000, 3000).

i_parmTr : changed max to 30000, 30000, 4800, 32766.

i_PODFixedPos : changed units to 3*(m,mm)

i_tpCentX : added, replacing spare7.

i_tpCentY : added, replacing spare8.

i_tpOrX : added, replacing spare2.

i_RMSpulseWd : added, partially replacing spare6.

GLA07-11:

i_cld1_mswf : updated documentation on GLA11.

i_cld1_od : updated units to unitless*1000 on GLA11.

i_aer4_od : updated units to unitless*1000 on GLA11.

i_pbl4_od : updated units to unitless*1000 on GLA11.

i_surfType : added, partially replacing spare1.

GLA06, 12-15:

i_cld1_mswf : updated documentation.

i_reflCor_atm : updated name and description.

i_AvgElev : removed from GLA13.

i_SiRufMaxPk : added, replacing i_AvgElev and spare7 on GLA13.

The latest product formats/descriptions will be available at http://wff-glas.wff.nasa.gov/v41_products/.

Known Problems

More improvements may be needed in sea ice roughness calculations. Validity of the additional parameter needs to be verified.

532 background in daylight conditions is not being computed properly.

Area fit of saturated waveforms still being investigated.

i_reflCor_atm is corrected only for the molecular optical depth; not for cloud and aerosol effects.

Laser transmitted energy calculation is incorrect.

40 Hz cloud layer height generation need improvement.

40 Hz cloud heights from the 1064 channel not implemented.

Need to replace estimated atmospheric transmissivity with actual in reflectivity calculation.

GLA02 browse product is not available.

GLA16 (HDF Level 3 product) not supported.

Release Information

The ClearCase label for this release is RELEASE_4.1.

Products generated by this software will be labelled as Release 19 by SDMS.

The release date is December 10, 2004.

Version numbers have been updated to “V4.1 November 2004" for the following:

- all libraries
- GLAS_L0proc
- GLAS_L1A
- GLAS_Alt
- GLAS_Atm
- GLAS_Meta
- ANC07
- ANC45

This should be verified during operation by checking the version information in the appropriate ANC06 files.

SMDS Impact

The distribution tarfile is on glasdev.wff.nasa.gov at the following location:

```
/glasdev1/v4/dist/gsas_V4.1.tar.Z.
```

ANC Files

New versions of the ANC07 and ANC45 data files are required.

The updated ANC33 file provided with the distribution should be ingested and used.

Bundle Changes

Start and Stop times are now required for granules specified in the QAPG control files.

ANC27 is now a required input for atmosphere processing.

For Browse jobs, the control file version keyword should be changed to reflect version 4.2. eg: VERSION=4.2

Compilation

All libraries and binaries should be recompiled using the top-level Makefile.

The process for making the libraries and binaries is as follows (**NOTE: SDMS ONLY!!**)

```
cd /install_dir/gsas_v4.1
make runtime
make install
```

Note : developers should not use the above procedure. This procedure is for SDMS only!

Detailed Change Notes

0001820: Problem generating QAP07 files for multi-file run

Bug was corrected which allowed multiple QAP07 files to be generated in a single GLAS_Atm processing run.

0001816: QAP03 browse jobs fail

Fixed bug in browse code so it will generate GLA03 browse products.

0001815: GLAS_Atm overflow for QAP09

A check was added to avoid using an invalid value as an input to averaging of ground height.

0001814: Energy Computation Is Wrong For Compressed WFs

The compression for NPQ type compression was being used backwards. This has been corrected. Energy was being calculated only from the area under the waveform above the noise. This has been changed by subtracting the area below the observed noise above the waveform in order to remove the contribution incorrectly calculated from the noise.

0001810: The Documentation For GLA05 Needs To Be Changed

i_parm1 : changed units to 0.0001 volts, 6*(0.0001 volts, 0.01 ns, 0.01 ns)

i_parm1 : changed min values to -30, 6*(0, -100000, 0)

i_parm1 : changed max values to 30000, 6*(30000, 0, 32766)

i_parm2 : changed units to 0.0001 volts, 6*(0.0001 volts, 0.01 ns, 0.01 ns)

i_parm2 : changed min values to -30, 6*(0, -100000, 0)

i_parm2 : changed max values to 30000, 6*(30000, 0, 32766)

i_solnSigmas1: changed units to 0.0001 volts, 6*(0.0001 volts, 0.001 ns, 0.001 ns); max values to 30000, 6*(30000, 3000, 3000).

i_solnSigmas2: changed units to 0.0001 volts, 6*(0.0001 volts, 0.001 ns, 0.001 ns); max values to 30000, 6*(30000, 3000, 3000).

i_parmTr : changed max to 30000, 30000, 4800, 32766.

0001806: Tweak to Cloud/Aerosol Discrimination

Lessened the functional dependence of latitude on the cloud-aerosol discrimination threshold levels.

0001797: MSWF documentation needs details

In the product database for GLA11, variable i_cld1_mswf: Added the description of the MSWF. In the description field I added the information listed above. In the PDF of i_cld1_mswf, I added the four bit set of values and the "NOTE" information as listed above. The reason for the piece meal in the Description and the PDF, was that there was not sufficient space in the DESCRIPTION & COMMENT fields to contain all of the information. Database/PDF updated.

0001794: Crash in GLA06 A2P for bad d_SigEndOff

Added checks for invalid values before all computations using data from gla05.

0001783: Waveforms crashes in anc08 module

A rare condition that arises when there is no transmitted pulse at the beginning of a processing run has been corrected.

0001781: ESDTs Rel 19 instrument state

InstrumentState, InstrumentStateDate, and InstrumentStateTime have been removed from all .met files, however, this information remains in the product header. The instrument state additional attributes information has also been changed from mandatory to not mandatory at NSIDC to accommodate file ingest where the metadata does not contain instrument state additional attributes.

0001779: IDL QA issues

Most changes involved program details that do not affect the appearance of the images, but simplify the code or make it somewhat more robust.

Updated COMPILE_OPT statement in all modules that were changed.

Refined setup of bars.

For the qa 7-11 products, the table locations were adjusted.

Titles were added to the color bars on the images for qa 7 and 10.

Tick mark locations corrected on qa 10 images.

Explanatory header added to one of the qa 5 plots.

Char size reduced for postscript output for all plots.

0001771: Overflow condition in GLA10_scal_mod

The GLA10_scal_mod routine was not altered to fix this problem. The location in the code where GLA10%d_cld1_sval2 is computed was located and a limit on its maximum value (327.0) was inserted. This was done in the routines A_opt_thin_mod and A_cld_opt_prop_mod.

These changes were then tested and verified by Steve McLaughlin and Jack Saba who ran the code on 3+ hours of data.

0001769: bad last record in GLA01

Fixed a problem where read_gla01 did not return immediately after getting an EOF on the main record.

0001767: Update metadata VersionID, VersionDescription

The GLA01-GLA15 .met files have been updated with the latest release 19 information.

0001766: Change metadata contact info

The GLA01-GLA16, and ancillary ESDT descriptor files have been updated with the NASA one e-mail address scheme. New contact information was added for John DiMarzio and Anita Brenner's contact information was removed.

0001765: Optical Density units GLA11

Changed the product units for the following variables in GLA11.

(changed unitless to unitless*1000)

i_cld1_od unitless*1000

i_aer4_od unitless*1000

0001761: GLA06/12-15 Variable i_reflCor_atm Mislabeled

The product database was changed for GLA06/12-15 variable i_reflCor_atm. The name and description were changed per requested change.

0001759: Modify IDL software to work with updated qap files for GLA 7-11

Changed IDL read, browse, and compare code to read, plot, and compare the updated qap07-11 data. Included in this fix is a change to qapc_faillevel.pro which should have been merged with Mantis 1390 but was missed.

0001758: Change QAPG to use new qapxx_mod for GLA 7-11

QAPG was changed to work with the updated qapxx_mod.f90 (xx=07-11) modules. The changes to the qap were made under Mantis 1699.

0001737: Software Problem Report

Fixed initialization errors in CalcQAP13 and CalcQAP15.

0001731: i_rng_UQF (GLA06,12-15) online documentation not consistent with code

Corrected setting of i_RngOffQF in ElevMgr and WFMgr.

0001726: QAP01 % APID 12/13 calculated incorrectly

The percent of waveforms, APID12 and APID13, calculation has been changed to use the total number of waveforms that are present.

0001713: Improve Alternate Fit of Some WFs

Changed W_LsqFit_mod to reset the noise parameter to the estimated value after each iteration. Fixed initialization of d_oldFitSDev in W_FunctionalFt_mod (this variable retained the previous value, so if the alternate fit had a smaller standard deviation of fit than the standard fit, an inappropriate choice would have been made when deciding whether to try a second fit).

0001707: Short anc32 File Sanity

There is a time problem introduced on the GLA products when an ANC32 file contains no valid GPS time latches. Implemented improved sanity checking for ANC32:

If number of anc32 records in a file < 2, ignore all data in the file.
If number of anc32 records available for processing < 2, error out with fatal error code.

Another catch was that the Error Description above failed to specify "good" records. I think the aforementioned error cases actually had more than 2 records in the ANC32 files, but all records but two were flagged as bad data.

0001699: Implement Along-track averaging QA for GLA7-11

The atmosphere products in GLA07 through GLA11 have received a major upgrade to the information that is available in the QAP files that accompany these products. All QA software has been rewritten to conform to GSAS norms for other products, which improves maintainability and readability. Summary data has been updated, and an along-track averaging capability has been added to provide periodic status information. Although variable, the default output rate is every 16 seconds or every 100 km of the satellite ground track.

0001696: All Browse 05 jobs are failing (Rel 18)

QABrowse modified to report correct status when processing GLA05 files.

0001681: GLA01 i_inststate spare bits are set but not documented as such

Provided new ANC33 file which has spare bits in instrument state changed from 1 to 0.

0001678: GLAS ATM bombs with integer overflow in gla07_scal_mod

Implemented a fix for a condition where a few bins of a 1064 profile had values that were physically implausible.

0001674: GLA04 LPA, LRS image descriptions need clarification/correction

The following product description changes have been completed to GLA04-01 (LPA).

i_boxX:: X Coordinate for the top left corner of the 20 by 20 LPA image data, 0 to 79. To map the LPA image into the LRS image the LPA image needs to be rotated 90 degrees clockwise. So the LPA rotated to LRS (column) upper left X corner is 79 minus i_boxY minus 19.

i_boxY:: Y Coordinate for the top left corner of the 20 by 20 LPA image data, 0 to 79. To map the LPA image into the LRS image the LPA image needs to be rotated 90 degrees clockwise. So the LPA rotated to LRS (row) upper left Y corner is i_boxX.

i_PixInt:: The forty per second images of the laser pulse. 20x20 box of LPA pixel intensity data. Row 1 column 1 to 20 first, then row 2 to 20. Row is Y and column is X. To map the LPA image into the LRS image the LPA image needs to be rotated 90 degrees clockwise.

The following product description changes have been completed to GLA04-02 (LRS).

i_T0_SA:: The image will be a 16 X 16 pixel image. The first word (2byte) in the PRAP data contains the frame number. It has been set to the same value as the second pixel so that automatic scaling in plots can work. Order of the data is: row 1 column 1 to 16; row 2 column 1 to 16; ....; row 16 column 1 to 16. Column is X and Row is Y.

i_lrs_RawRow:: Raw row data from LRS SA-2 trackers 0-2, Samples 1-10. Raw Row (Y axis) is the upper left hand corner Y position of the LRS 16x16 image array (i_T0_SA).

i_lrs_RawCol:: Raw column data from LRS SA-2 trackers 0-2, Samples 1-10. Raw column (X axis) is the upper left hand corner X position of the LRS 16x16 image array (i_T0_SA).

i_VTCentR:: Centroid Row from LRS SA-2 Virtual Trackers 0 - 2, Samples 1-10. Row is Y. The row (0 to 15) within the image data (i_T0_SA) is i_VTCentR minus i_lrs_RawRow.

i_VTCentC:: Centroid Column from LRS SA-2 Virtual Trackers 0 - 2, Samples 1-10. Column is X. The column (0 to 15) within the image data (i_T0_SA) is i_VTCentC minus i_lrs_RawCol.

0001672: QAPCompare, QAPRead changes for GLA01 and GLA05 metadata

QAPG changed to write a header record with product-to-algorithm scale factors for all parameters relevant to the calculation of the qap data.

qapread changed to read the additional header record.

qapcompare changed to output correct values for GLA01 and 05 metadata parameters.

0001670: Problems with waveform QA

Changed count of noFit WFs to include only those WFs that have a signal. Added code to make sure that QA records with time=0.0d0 or with no valid data are not written to the QAP file.

0001668: Sea ice roughness parameters not calculated correctly on GLA13

Improved calculation of sea ice roughness parameters and added new sea ice roughness parameters to GLA05 and GLA13. (See product change section).

0001667: QAPG changes for metadata requirements

QAPG was changed to write header record with product-to-algorithm scale factors for all parameters relevant to the calculation of the qap data.

QAPRead was changed to read the additional header record.

iQA100tFrm(gwi_ndx_a) was being double counted. Removed line that was adding giNumWf for every frame. Left line that is adding 1 for each valid waveform.

- the count of waveforms with signal in both along-track and summary QAP records should be based on the value of the no signal flag in L_WFQual, because the value of this flag is used to determine if a fit will be attempted.

Changed code to compute a mean value if there is at least one point, set the std dev to invalid for < 2 points, and compute a std dev for at least 2 points.

0001666: QAPG should get requested file times from control file

Mantis 1666 changes QAPG to allow it to read start and end times from the INPUT_FILE and OUTPUT_FILE lines in the control file. Times from the INPUT_FILE lines are ignored. If times are not present in the control file, they are taken from the first and last valid shots in the input file. These times are used ONLY for products where the start and end times in the summary record of the main QAP file (the one produced by the run that generates the product file) are taken from the control file.

CURRENTLY, TIMES ARE NOT PUT IN THE QAPG CONTROL FILE. THIS WILL REQUIRE A CHANGE IN ISIPS AND SCF PROCEDURES.

0001657: Add LPA orientation parameters to GLA05

Added i_tpCentX, i_tpCentY & i_tpOrX to gla05. Changed

l_WFqual(31,40) to l_WFqual(32,40). Added gwi_spare32 to

const_wf_mod. In anc09_pad_mod, changed Spare1(i*4) to

i_tpCentX(i*2) & i_tpCentY(i*2), and Spare2(r*4) to

i_tpOrX(i*2) & Spare1(i*2).

0001634: Land/Ocean Flag added to Atmosphere Products

The parameter surftype, identical to that currently appearing in products 6 and 12-15, has been added to the atmosphere products 7-11. It provides a flag showing the pre-

defined surface type (Land, Sea ice, Ocean, or Ice sheet) or surface type combinations for every observation. Because of this added functionality, control files for GLAS_Atm must now include the two anc27 files which store the surface type flag values.

0001628: Gain reported is delayed in application

Implemented a 1-shot gain shift which is applied during the following conditions:

1) The delta time between previous and current shot is < 0.3 sec AND

2) The corresponding i_RespEndTime < 4500000 ns

A new flag (i_GainShiftFlg) was added to GLA01. Each of the 40 flags indicates if the corresponding gain measurement was shifted. If the gain was not shifted, the existing gain measurement is used and the corresponding flag set to 1. A flag with value 0 indicates the gain measurement was shifted normally.

0001625: GLA05 browse products: locations reported on along-track scatter plots incorrect

The calculation of latitude and longitudes printed at the start and end of the data on the along-track plots was corrected.

0001403: Merge QAPxx modules with elevation code

Mantis 1403 integrates the elevation qap modules that are being used with QAPG into the elevation code.

0001402: Waveform ATBD change needed

The specification of the meaning of individual bits in the flag words should not be included in the ATBD. These are documented in the online descriptions, and the ATBD should point to this documentation.

0001390: Elevation QAP changes for metadata

Updates for metadata, especially for the elevation products.

For the Fortran code:

1. Elevations: QAPxx_MOD.f90 modified to add new parameters to the qa files.

2. QAPG: changed to write scale factors to the file headers to facilitate

comparison of the qa files written by L1a, Waveforms, and Elevations code

with the files written by QAPG.

For the IDL code (QAPRead, QAPCompare):

1. Added the ability to read scaling factors from QAP file header.

2. Changed QAPCompare to

- Use the scaling factors when comparing the primary and alternate QA files

- Generate valid automatic qa metadata parameters for elevation products

- Generate valid operational qa for the products for which this is

currently possible -- GLA01, 04, 05, 06, 12-15.

3. Updated elevation qa summary data structure.

Parameter QAP06,12,14 QAP13 QAP15

NShotsInFile x x x

NInvalidElevation x x x

NInvalIdreflectivity x x x

NInvalidRoughness x x

NInvalidSlope x

4. Included minor cleanup and documentation changes.

5. Changed default QAP file Version. VERSION=4.1: Because of changes to the

GLA01, 6, and 12-15 QAP files, the Version number in the control files

should be changed to 4.1 after the associated Mantis items are merged.

0001386: QAP01 changes for Metadata

Modifications for GLA01 metadata calculations.

Modules changed:

QAP01_mod.f90:

- i_NumMissingRange and i_NumNoData added to qap01 summary data structure and computed.

/glas/vob/src/qapg/qapg_elev_mod.f90: Added 2 elements to GLA01 SumP-armIndices.

/glas/vob/idl/qa_browse/compare/qapc_metadata.pro: Correct component name: change FailureLevel.GLA013 to FailureLevel.GLA13

/glas/vob/idl/qa_browse/util/qap01V2_datastruct.pro: Added component num-bers to the comment filed for each component of both structures.

0001273; No valid QA for GLA08-11

Atmospheres QA for products GLA08-GLA11 have been repaired so that acceptable data is now always being output. QAP data output is a single summary record. Pre-vious outputs were usually missing, since they were only output when interval times happened to match even values of 20 seconds.

0001267: GLA09 Aerosol / Cloud Discrimination and Layer Detection

Added a latitudinal dependence to the cloud/aerosol discrimination. Prior versions had trouble in the high latitudes where cirrus-like clouds extend to the surface. The misidentification of these clouds as aerosol is now corrected.

Added a transmission correction to the cloud aerosol discrimination routine. When there are multiple layers present, the signal strength of the lower layers is diminished due to the attenuation of the layers above. The weak signal of the lower layer often looks like aerosol. This transmission correction will help with the correct classification of multiple layers.

Added code which checks for horizontal continuity of aerosol layers. This is used to reduce the occurrence of false positives

Added a rudimentary cloud/aerosol discrimination for the 1064 layer detection. The low resolution cloud use flag is now given a value of 3 when the layer was detected using the 1064 channel and that layer is deemed aerosol. The use flag has the value of 2 if it was detected using the 1064 channel and it is thought to be cloud.

0000839: Release 12 GLA05 problems discovered in QA data

Fixed several GLA05 QA problems -

- Corrected calculation of % of waveforms with no signal.

- Corrected calculation of the histogram of the distance from wf centroid to

center of last peak.

- Invalids are no longer included in the histograms.

- Changed min value for histograms of two standard deviations to zero.

Modules affected:

common_libs/math_lib/w_add2hst_mod.f90

- Return bin number = 0 if value = invalid.

qapg/qapg_elev_mod.f90

- Corrected error that was telling the QA Browse program that the histogram

of the number of initial peaks was not computed.

qapg/qapg_gla05_mod.f90

- qapg/qapg_gla05_sum.f90

- % no sig, sat, etc are set to Invalid in the output record if there are

no bad data. This is because with initialization to 0, there is no

way to distinguish no bad data from no data. Changing initialization to

set them to invalid, and other code to test for this condition.

- Corrected limits and n elements for histogram of number of initial peaks.

waveforms/W_Assess/W_Assess_mod.f90

- Moved code that sets the along-track record start and stop times

waveforms/W_Common/QA_wf_mod.f90

- Changed lower limits for histograms of fit noise and peak locations standard deviation to zero.

waveforms/W_CreQAStats/W_CreQAStats_mod.f90

- Do not write the along-track record if the times are zero.

waveforms/W_FunctionalFt/W_FunctionalFt_mod.f90

- Ignore invalids during data collection.
- Allow the histogram of distance between waveform centroid and center of last peak to have negative values.
- Added code to accumulate the composite histogram of number of final peaks.

ATTACHMENT A

LEVEL 2 SEA ICE PRODUCT - GLA13

The sea-ice algorithm is designed to provide estimates of:

a. Average range to the surface of smooth or randomly rough ice or of open water within the footprint will be inferred from the time delay of the centroid of the best-fit Gaussian associated with the maximum amplitude peak in the return pulse. For sea ice, this elevation will be slightly above the local sea surface, and time series of such data might provide an indication of the temporal variability of sea-ice freeboard during the period of the mission if we also have information on temporal variability of sea-surface elevation in the same regions. For orbit tracks crossing open-water leads and polynas, it should be possible to estimate the freeboard of surrounding sea ice, giving an indication of sea-ice thickness (Wadhams et al, 1992), as proposed by Peacock et al, (1998) using satellite radar-altimeter data.

Products:

i_elev: sea ice surface elevation, which is the “surface elevation wrt ellipsoid at the spot location determined by range using the sea ice specific fitting procedure after atmospheric delays and tides have been applied”. Computed from the reference range to the surface by applying the correction of i_siRngOff defined as “range offset to be added to i_refRng to calculate the range using the algorithm deemed appropriate for sea ice”.

b. Average range to all surfaces in the footprint will be inferred from the time delay of the centroid of return waveform above noise threshold. For smooth and randomly rough sea ice and for open water, this should be almost identical to (a). The difference between (a) and (b) gives an indication of whether a significant fraction of

the footprint is occupied by a large ice ridge or an iceberg, causing an asymmetric, non-Gaussian return waveform.

Products:

i_AvgElev: Average elevation of all surfaces in the footprint from the centroid of the raw waveform with all corrections applied. Computed from the reference range to the surface by applying the correction of i_cntRngOff defined as "offset to be added to i_refRng to give the range in distance to the location of the centroid of the received echo from signal begin through signal end defined by the standard parameters."

c. Sea-ice surface roughness estimates will be obtained from the RMS width of the whole return pulse as well as from the RMS width of best-fit Gaussian associated with its maximum peak. The first is a measure of the total surface elevation variation, and the latter a measure of the roughness of the smooth ice of or open ocean surface within the footprint.

Products:

I_RufSeaIce: The RMS width of the whole return should be computed as follows:

where A(i) contains the waveform as it is quantized in both time and voltage and _t is the digitizing interval. The index runs from the first threshold crossing to the last threshold crossing. The rms_width is given in sec and it should be converted into distance units using (9). The idea of computing the rms_width this way is adapted from the waveform simulator (page 36). The width is actually equivalent with the standard deviation of the population that has a histogram of the ICESat waveform.

i_SiRufLstPk: The surface roughness over the footprint calculated empirically from the transmitted and received waveforms using the RMS width of the maximum peak.

I_AvgRuf is not defined.

d. Range to the highest surface in the footprint will be inferred from the time delay of the centroid of the best-fit Gaussian associated with the first peak in the return waveform. This indicates the highest large roughness element, or surface of iceberg, floating glacier tongue, or land within the footprint.

Products:

i_BergElev: For waveforms with more than 1 peak, 'iceberg' elevation is calculated using the difference between the range offset of the maximum amplitude peak and the range offset of the first peak. Computations are made after atmospheric and tide corrections have been applied. The elevation computed is relative to the ellipsoid. Users should be wary that this parameter is computed for all multiple-peak GLA13 records, even if the elevation is too high to be sea-ice.

e. Average reflectivity within the footprint will be obtained from the total energy in the return pulse, taking account of the transmitted energy, height of spacecraft, receiver characteristics etc.

Products:

i_reflctUncorr:

The reflectance (not corrected for atmospheric effects) is calculated as the ratio of the received energy after it has been scaled for range, and the transmitted energy. The corrected reflectance may be calculated from this uncorrected reflectance by dividing by e^(-2(tc+ta+tm)), where tc is the cloud (column) integrated optical depth, ta is the aerosol (column) integrated optical depth, and tm is the molecular optical depth. This uses all signal between signal begin and signal end.

Attachment B

Revised Alternate Waveform Fitting Release Notes for Release 19

D. Harding, 12/08/04

Alternate waveform fitting results through Release 18 typically yield only one or several Gaussian peaks that do not fully characterize the shape of complex waveforms from areas of significant relief and/or vegetation cover. The alternate solution for waveform fitting in Release 19 has been revised in order to more accurately fit complex waveforms. The determination of initial Gaussian fits is done as in prior releases, based on zero-crossings in the second derivative of a smoothed version of the waveform. The six largest Gaussian fits by area are then input to a least squares fitting routine that iteratively adjusts Gaussian amplitudes, positions and widths to minimize the difference between the sum of the six Gaussian fits and the received waveform. Three changes have been made in Release 19 in this least squares fitting procedure: (1) six Gaussian fits are always retained (in prior releases the number was allowed to decrease), (2) the base-level for the Gaussian fits is forced to be the mean level of the background noise (in prior releases the base-level could increase above the mean noise level), and (3) the Gaussian center positions are constrained to be between signal start and end defined by the alternate threshold.

The amplitude, location, and width of the six Gaussian fits are reported together in i_parm1 in GLA05 and in i_Gamp, i_gpCntRngOff, and i_Gsigma, respectively, in GLA14. The GLA products minimum for Gaussian fit amplitude is 0.0001 volts. Any Gaussian fit amplitude less than the minimum will be reported as 0 in the data products.

A goodness-of-fit measure, the standard deviation of the difference between the sum of the Gaussian fits and the received waveform, is reported in i_wfFitSDev_1in GLA05 and i_LandVar in GLA14. Standard deviation values of less than 0.05 correspond to reasonably well fit waveforms. The alternate fitting procedure yields anomalous, very poor results with standard deviation values above 0.1 in a small percentage of cases (estimated to be about 5%).

The Gaussian fit results are a useful means of representing the received waveform in a compact, compressed form. Summing the six Gaussian distributions provides an approximation of the received waveform shape for those waveforms with low goodness-of-fit standard deviation results.

In addition, the peaks of the receive waveform provide information about the vertical distribution of scattering from the surface within the laser footprint. This Gaussian fitting approach provides a useful, although non-unique, representation of the scattering height distribution. Inversion of the waveform distribution to obtain geophysical surface properties is an area of ongoing research.

5.3.2 GSAS v4.2 Release Notes

Introduction

GSAS Release 4.2 fixes a problem which caused GLA06 PAD data to be passed directly from GLA05, (mostly) bypassing any PAD input files. GSAS 4.2 will correspond to Product Release 21 and only be run on elevation products with Release 15 PAD.

For Elevation, the following changes were made:

o Fixed a a data synchronization issue that occurs when GLA09/11 are input to elevation processing which caused the ANC09 data to be unavailable for a large percentage of the time.

o Fixed an unrelated problem where a large number of instrument state changes caused an array overflow error.

Product Format/Definition Change Summary

None. The product database will not be updated for the GSAS 4.2 release.

Known Problems

Same as noted in Release 4.1.

Additionally, flagging does not correctly indicate when GLA05 pass-thru PAD is used in place of data from ANC09.

Release Information

The ClearCase label for this release is RELEASE_4.2.

Products generated by this software will be labelled as Release 21 by SDMS.

The release date is March 10, 2005.

Version numbers have been updated to “V4.2 March 2005" for the following:

o Lib_exec

This should be verified during operation by checking the version information in the appropriate ANC06 files.

SMDS Impact

The distribution tarfile is on glasdev.wff.nasa.gov at the following location:

/glasdev1/v4/dist/gsas_v4.2.tar.Z.

ANC Files

New versions of the ANC45 data files are required.

Bundle Changes

None

Compilation

All libraries and binaries should be recompiled using the top-level Makefile.

The process for making the libraries and binaries is as follows (NOTE: SDMS ONLY!!)

cd /install_dir/gsas_v4.2

make runtime

make install

Note : developers should not use the above procedure. This procedure is for SDMS only!

Detailed Change Notes

0001902: GLA06 uses GLA05 PAD when GLA09/11 inputs specified.

Fixed a data synchronization issue that occurred when GLA09/11 were input, causing the ANC09 data to be unavailable for a large percentage of the time. This problem had been present since the GLA09/11 became allowable inputs. It was hidden because the ANC09s input to GLA05 and GLA06 have been the same till the mix between release 19 and release 20.

Noted (but did not fix) an issue that some flag should have indicated that data from GLA05 instead of data from ANC09 was used.

Also fixed a problem where insufficient checks were done when creating the array of unique instrument state updates from input product headers.

5.3.3 GSAS v4.3 Release Notes

Introduction

GSAS 4.3 contains significant improvements to the Waveform alternate fitting process, an improved energy calculation, Atmosphere improvements and numerous QAP tweaks. The major changes are summarized below:

For L1A, the following changes were made:

o Improved energy calculation.

For Waveforms, the following changes were made:

o Restructured the Waveform Manager.

o Improved energy/reflectance calculations.

o Saturation Index added

o Significantly improved waveform alternate fitting process. The changes make the process more compliant with the ATBD and significantly improve processing time. The changes are detailed in the next three bullets:

o Alternate fit uses the normalized waveform based on area before functional fit. (Standard fit uses raw voltage waveform).

o Alternate fit uses up to 5 largest peak plus peak nearest ground. The algorithm keeps all 6 peaks but amplitudes are allowed go to zero.

o Alternate fit least square exit criteria changed. Maximum iterations are now significantly less frequent. In fact, if maximum iteration flag is set, data should not be used (or used with caution).

For Elevation processes, the following changes were made:

o Restructured the Elevation Manager.

o Fixed synchronization problem caused by atmosphere data input.

For Atmosphere, the following changes were made:

o Added control file sanity checking.

o 532 cloud layer detection improved. Changes made result in the 40 Hz cloud search being executed for every shot, independent of the results of cloud searches at lower resolutions. Also the starting height for the cloud search is now 10 km, which means that clouds will now be reported when found up to the 10 km altitude (in prior versions, 4 km was the maximum). These changes mean that a cloud could be reported for one or more 40 Hz shots of a given second, while no cloud was reported at the 1 second or 5 Hz resolution

Other, more general fixes include:

- Updated ANC45 versionID and parameter names.
- General code cleanup.
- Improved product database descriptions.
- General QA/Browse fixes.

Product Format/Definition Change Summary

GLA01:

Changed the Algorithm variable type and name of i_GainShiftFlg in GLA01.

GLA-01, 02, 05-07, 12-15:

Changed the listings for GLA01,02,05-07,12-15 as a pass-thru for i_OrbFlg.

GLA05:

Changed the product units for i_RMSpulseWd in GLA05.

Changed variable i_spare6 and added new variable i_satNdx in GLA05.

GLA05-06, GLA12-15:

Made i_FrameQF a pass-thru for GLA05-06,GLA12-15.

GLA05-07, GLA02-15:

Changed description for i_beam_azimuth in GLA05-07, GLA2-15.

GLA06:

Changed description of i_MRC_af in GLA06 and created a new one byte flag PDF.

GLA06, GLA12-15:

Change to i_CorrStatFlg parameter in GLA06, GLA12-15, bits 4,5,6.

GLA07:

Changed product units in i5_ir_bscs, i40_ir_bscs, i_g_mbscs, & i_ir_mbscs in GLA07.

GLA13:

Changed algorithm units for d_SiRufMaxPk in GLA13.

Changed the description for the value=1 of bit 3, i_SiRufQf, GLA13.

GLA14:

D_Gamp and d_Gsigma now contain values

The latest product formats/descriptions will be available at http://glas.wff.nasa.gov/v43_products/.

Known Problems

A test in the received energy calculation based on the noise signal standard deviation is not being performed.

An investigation is needed for the alternate fit related to tuning parameters and always keeping 6 peaks.

40hz cloud heights based on 1064 channel in atmosphere processing are forthcoming.

SRTM DEM improvements are forthcoming.

Standard fit was found not to being performed as ATBD specifies, but was not changed.

Fit standard deviation for alternate is based on a normalized waveform, but for standard is based on raw waveform.

Significant product format changes (including record size changes) are forthcoming in the next major release of GSAS.

Release Information

The ClearCase label for this release is RELEASE_4.3.

The release date is May 12, 2005.

All internal version numbers have been updated to “V4.3 May 2005". This should be verified during operation by checking the version information in the appropriate ANC06 files.

SMDS Impact

The distribution tarfile is on glasdev.wff.nasa.gov at the following location:

/glasdev1/v4/dist/gsas_V4.3.tar.Z.

ANC Files

New versions of the ANC07 and ANC45 data files are required.

Bundle Changes

Sanity checking is now enforced in GLAS_Atm. This may impact partial processing if the planner specified more inputs/outputs than are actually required. If this occurs, sanity checking can be turned off by inserting an "OVERRIDE=TRUE" line in the control file.

QAP04 should be removed from the GLAS_L1A bundle. QAP04 is now produced by QAPG.

Compilation

All libraries and binaries should be recompiled using the top-level Makefile. IMPORTANT: due to internal changes in the makefiles, SDMS MUST use the command "make runtime" to ensure the software is made without debug flags.

The process for making the libraries and binaries is as follows (NOTE: SDMS ONLY!!)

cd /install_dir/gsas_v4.3

make runtime

make install

Note : developers should not use the above procedure. This procedure is for SDMS only!

Detailed Change Notes

0001972: Force energy computation for GSAS v4.3

Modified the global constants file in order to nullify a mis-coded signal amplitude check in the received energy calculation.

0001970: Energy quality flags disconnected between products in database

Changed the listings for GLA02 and GLA07 as a pass-thru for i_g_TxNrg_qf and i_ir_TxNrg_qf.

0001967: Error while generating GLA04 browse products

Fixed bug that caused undefined variable.

0001966 : VersionID for GSAS 4.3

Updated the VersionID and Version Description for GSAS 4.3. GSAS 4.3 will correspond with Product Release 22.

0001962: QAP version number is wrong

The QA version number was updated to 4.5 for the metadata change to the QAP03 files.

0001959: Patch WF code for acctest

A temporary fix was added to the new waveform code in order to stop a floating point exception error. Mantis 1965 was opened to perform future investigations on the alternate fit always keeping 6 peaks.

0001953: i_OrbFlg disconnected among products in database

Changed the listings for GLA01,02,05-07,12-15 as a pass thru for i_OrbFlg. Left GLA08-11 as a separate listing. Also changed the Maximum Product value to 128 on GLA01,02,05-15.

0001950: GLA07 Product Units

Changed the product units for variables in GLA07: i5_ir_bscs, i40_ir_bscs, i_g_mbscs, & i_ir_mbscs to e11/(m-sr). NOTE: Last Modified date for the four variables was August 08, 2001.

0001945: Alternate Waveform Fit converge exit test and peak combine changes

Corrected error in LsqFit that was computing the goodness of fit for the wrong iteration. Implemented new convergence criteria for alternate fit.

0001930: IDL Portion of 0001922

Sample waveform reader code was developed and packaged as part of the SCF IDL readers.

0001927: Add IDL VM version of QA print utility

An IDL virtual machine procedure is now available to print the contents of a QA file to an ASCII file.

0001926: Update QABrowse and read s/w for changes to QAP03

New QAP Version = 4.5

The IDL read procedures were modified to handle the updated QAP03 summary record format.

The browse program was modified to add % missing GLA03 to the first browse image.

0001924: Add sanity check override flag to PGEs

Added sanity check override flag to StdCntl. Added check for this flag to GetControl subroutine of each PGE (glas_l0p, glas_l1a, glas_alt, glas_atm, glas_meta, glas_reader, glas_tick).

Flag is specified in the control with a line:

OVERRIDE=TRUE

The flag default is FALSE. No other value other than TRUE switches the flag on. If the flag is turned on, no sanity checking occurs and a WARNING error is written to the ANC06 indicating that no sanity checking of the control file was performed.

0001923: Bug in ErrorInit_mod.f90

Fixed a previously undetected overflow condition in ErrorInit_mod.

0001922: GLA01 waveform reader

Created two GLA01 waveform readers: one base on the SCF reader code, the other based on GSAS readers. The GSAS-based reader show how to merge GLA01 and GLA05 data. Both readers expand the waveforms and convert from counts to volts.

0001919: Need to change method used to get aux. info to the IDL code

QAPG no longer writes the along-track or summary parameter flags or scale factors to the header of the QAP file. The IDL readers now read this information from the data structure file when available, or from the QAP headers (if available, as in the past) when it is not in the data structure file.

0001913: Elev mgr crashes on integration branch

Not an error. This was caused by an incorrect control file. However, a request will be added to implement code sanity checking for WF and ELEV processing.

0001910: WF QA does not write summary record in a specific case.

Fixed problem where QA summary packets were not being written when several QAP05 files were being written in one job.

0001905: WFMgr does not re-initialize QA start time for new granule

Moved dW_tEnd to top of module so it is accessible from GLA05_granule_init.

Put code in GLA05_granule_init to re-initialize dW_tEnd with the GLA05 time+QA_dump_tme upon start of a new granule.

0001904: Duplicated Code In WFMgr & L_EngCorr

Removed duplicate code in WFMgr and L_EngCorr.

0001903: WFMgr Calculating Energy With Wrong Instrument State

Corrected error in WFMgr introduced on branch gcr0001853.

0001882: clarify description Bit 3 i_SiRufQF

Changed the description for the value=1 of bit 3, i_SiRufQF, GLA13.

New Description:

1=valid values do not exist for slope and roughness

0001878: i_FrameQF database entry for GLA06 vs. other products

i_FrameQF was made as a pass-thru for GLA05,06,12-15. GLA06 is no longer has its own entry.

0001876: units for i_RMSpulseWd wrong on V4.1 database for GLA05

Changed the product units for i_RMSpulseWd from 'ns' to '100 ns'.

0001874: V4.1 database wrong for d_SiRufMaxPk on GLA13

Changed algorithm units for d_SIRufMaxPk in GLA13 from 'cm' to 'meters'.

0001871: QAP04 difference between L1a and QAPG

QAP04 generation was removed from GLAS_L1A. QAP04 is now generated exclusively by QAPG.

0001863: GLA06 i_MRC_af description

A new one byte flag PDF has been created for i_MRC_af. The description has also been changed for i_MRC_af to reflect the new PDF flag.

0001862: i_beam_azimuth definition change

The description for i_beam_azimuth in GLA05-07,12-15 has been changed.

0001858: Add saturation index to GLA05

As a description of the saturation index., gla05%i_satNdx (40 per sec) is the count of the number of gates in a waveform which have an amplitude greater than or equal to i_satNdxTh (set in anc07_0004). i_satNdx has a minimum value of 0 and a maximum value of 255 (values greater than 255 are reset to 255 before being written to the product).

0001854: Update IDL code to work with changed GLA02 QAP files

QAP VERSION NUMBER = 4.3. This parameter has to be updated in the QABrowse control files at SDMS and SCF.

Added "Frames" to text on upper level plot for clarity.

Added image data to GLA02 browse products.

Eliminate use of Extract_FileName. Module can be dropped from the distribution.

Fixed problem with handling files with only 1 orbit of data (or less).

Fixed problem with handling old versions of GLA07-11 QA files.

Improved handling of images with a small data range.

0001853: GLAS_Alt manager cleanup

Significantly restructured the GLAS_Alt Manager code. This should make the code easier to understand and easier to maintain.

0001848: V4.1 product database incorrect

Made change to i_GainShiftFlg in GLA01_main. Changed the Alg Variable type to lrb and the Alg Variable Name to l_GainShiftFlg.

0001841: Bad QAP12 file

A temporary patch was installed in the IDL code that reads the QAP files to fill in constants that are missing from the elevation qap file summary records. A permanent fix is ready for installation but involves Fortran code, which will not make it into Release 19. Branch 1841.

0001836: IDL QA color table path problem

The FILE_WHICH routine allows the color table file to be located as long as it is in the IDL path. If it is not, the program throws an error.

The final (rightmost) lat/lon label on the plots was sometimes incorrect. This happened when the endpoint of the plot was significantly after the end of the data. This was fixed by forcing the plot to cover just the time period with data.

This fix:

- allows the program to locate the color table file without regard to the directory structure in which the files are stored. It IS necessary for the file to be in one of the directories that is in the IDL path.

- eliminates duplicate copies of images that were being written to the HDF file.

- corrects a problem with qap10 browse products that was putting each panel on a different plot.

- adds plot start and stop times to the QAP07 and 10 images.

0001830: GLA14%d_Gamp and GLA14%d_Gsigma Not Set

Not needed. GLA14%d_Gamp & GLA14%d_Gsigma are set in Pass_GLA05, which is called in ReadRecord.

0001822: Rel. 19 polar projection plots too large on browse products

A bug that caused mapped elevation data to be put on a polar projection rather than a cylindrical projection in some cases was fixed.

0001780: GLA06 and GLA05 metadata file does not have the same number of instrument states

Fixed problem in common_hdr_update which caused an additional Instrument State to be added to certain granules.

0001763: Replace estimated atm. trans. with actual in reflectivity calculation

Reflectivity corrected for atmospheric effects, as seen in products GLA06 and

GLA12-->GLA15, is now derived using computed atmospheric parameters from product GLA11.

0001750: Laser xmit and received energy calculation incorrect

The method for calculating the area used to calculate energy has been changed. A new correction term for the field of view has been added to the formula for the transmitted energy. The values of some of the constants used to calculate energy have changed.

0001708: Change to 40 Hz cloud layer height generation

The changes made to the code in this mantis affect the 40 Hz 532 channel cloud heights only. The product format does not change. Previous versions of the software also produced 40 Hz cloud heights from the 532 channel but the following differences have resulted from this mantis:

1) In prior versions of GSAS, the 40 Hz cloud search was only executed if there was a cloud found below 4 km at the 5 Hz resolution, which in turn was not executed unless there was a cloud found at the 1 second resolution.

2) Changes made under this mantis result in the 40 Hz cloud search being executed for every shot, independent of the results of cloud searches at lower resolutions. Also the starting height for the cloud search is now 10 km, which means that clouds will now be reported when found up to the 10 km altitude (in prior versions, 4 km was the maximum).

3) These changes mean that a cloud could be reported for one or more 40 Hz shots of a given second, while no cloud was reported at the 1 second or 5 Hz resolution.

0001616: GLAS_ATM options sanity checks

Implemented sanity checking for GLAS ATM.

0001414: Parameter name duplication in QAP02 and QAP06

The issue was determined to be an alternate platform compiler problem.

0001399: Version number for QAPRead

All processes that write QAP files were changed to add the QAP file version to the QAP header record.

0001389: QAP04 changes for metadata

L1a was updated to add GLA04 metadata parameters to the GLA04 QAP file.

The IDL code was updated to display this information on the browse images, and to use it to generate the metadata file.

QAP VERSION IS NOW 4.4. This has to be updated in the QABrowse files at SDMS and SCF.

0001388: QAP03 change for metadata

QAP03_mod.f90 was modified to add three summary variables to calculate the percent of 16 second records for which any of the following APID's are missing 19, 20, 21, 22, 23, 24, 25, 55. d_pctmiss_GLA03, i_exp_GLA03, i_numbad_GLA03 were the variables added to the QAP03_Sum_Out_TYPE structure.

The apid availability flag is counted for each apid, and if any are missing the QA_Sum%Sum_Out%i_numbad_GLA03 is incremented to count the missing apid.

0001387: QAP02 change for Metadata

QAP02 data has received supplemental APID counters. A few minor internal code problems in QAP07-QAP11 were repaired.

0000617: GLA13 QA problem regarding Sea Ice roughness

Inspection of a current copy of a text-formatted printout of GLA13 QAP file and of a copy of the first page of the png graphics for that file showed that previous problems flagged in Mantis 617, specifically regarding a lack of displayed values for two sea ice roughness parameters, appear to have been rectified. Both the graphics output and the availability of numerical data used as inputs to those displays are now correct. This problem has been corrected by the large scale re-write of the ElevMg.

0000371: dry trope correction has blips

An error has been corrected which allowed inadvertent values to be recorded in the 06,12,13, and 15 GLAS elevation products for the range correction due to the dry troposphere (i_dtrop). The error appeared as a sporadic offset (also called a "blip") in the values from the expected dry trop values.

5.3.4 GSAS v5.0 Release Notes

Introduction

Version 5.0 is a major release of GSAS. Most changes affect the Level1B and Level2 products. Only minor changes were made in L1A processing.

L1A Change Summary

A correction was made to the EU conversion of GLA04 IST i_VTBoreH and i_VTBoreV.

Altimetry Change Summary

The key change made to the altimetry products is the lengthening of all of the L1B and L2 products allowing space for new variables and additional growth. These new variables include:

- A high-resolution DEM value from the SRTM V1 90m resolution DEM for latitudes between 60N and 60S
- Gain and received energy placed on all of the level 1b and 2 products.
- Surface pressure, temperature, and relative humidity on all level 2 products
- Saturation range correction for low gain (13 counts) returns.

- 1064nm cloud top and integrated signal from the lidar team (40Hz)

Changes have been made to both the transmit and received energy calculations as suggested by the instrument team. For details of the energy computation see the waveform ATBD.

Two minor changes have been made to the standard parameterization waveform fitting. The standard fit now uses the absolute peak location change instead of a percentage change as the convergence criteria in the gaussian fitting. An error in the computation of the standard fit sigma has also been corrected. Neither of these changes has significantly affected the elevations on the data.

In the alternate waveform fitting, an option to normalize the waveform based on the peak amplitude was implemented. An error in reporting the alternate fit standard deviation was corrected and the precision was changed on the product to accommodate the smaller numbers. The alternate fit parameters were changed to perform normalization by peak amplitude before fitting, the minimum distance between selected peaks was set to be greater than 15 ns, and the weight of the sigma widths was tuned to provide the best alternate fits on selected land waveforms.

Atmosphere Change Summary : Status and Limitation of 1064 Cloud Detection.

Through ISIPS release 23, cloud detection using the GLAS 1064 nm atmospheric channel was limited to 4 and 1 second resolution. This was due mainly to the low inherent signal to noise of the 1064 data. Over the last 6 months or so, we have been striving to produce 1064 cloud top height on a shot to shot basis (40 Hz). The new algorithms have been tested and are included in this release of GSAS. The limited amount of testing done to date has shown that we can definitely detect clouds at this resolution, though the exact limits of what can be detected (in terms of optical depth) have not yet been quantified. An assessment will be performed after the laser 2a data has been reprocessed using this release of the GSAS software by comparing the 1064nm cloud detection with that of the 532nm channel. A part of the cloud detection algorithm is based on the integrated 1064 nm signal, which is also stored as a separate quantity on the release 24 GLA09 product. Testing has shown that when the magnitude of the integrated signal exceeds a certain threshold, it is highly likely (as corroborated by the 532 channel) that there is a cloud present even if the thresholding algorithm did not detect a cloud. In this case, the cloud height is set to 10 km and a flag is set to indicate this fact. The algorithm also interrogates the ground return signal width in an effort to detect very low clouds. Over flat terrain like the ice sheets, the 1064 ground return signal has a characteristic width. When this signal is unusually wide, and clouds have not been detected higher up, the cloud top height is set to 100 m and a flag is set to indicate the likely presence of low clouds. While these approaches improve the overall cloud detection, they too have their limits. We'll have to wait until we can perform extensive testing to determine what those limits are.

Product Format/Definition Change Summary

Record length was changed for the following products:

GLA06: 6880

GLA11: 3032

GLA12: 6600

GLA13: 6760

GLA14: 10000

GLA15: 6280

GLA05:

Changed scale and Max Value for parameters: d_wfFitSDev_1, d_wfFitSDev_2 & d_DevFitTr. Scales from 0.001 to 0.0d-5 and max value from 300 to 3000.

Changed the description for i_elvflg and i_SurfRuf_slpQF

Changed spare6 to spare6 (110).

Added the following new parameters:

i_RecNrgAll (40)

GLA06:

Changed record length to 6880.

Changed the description for i_elvflg and i_SurfRuf_slpQF

Changed definitions for i_CorrStatFlg

Added i_DEM_hires_src & i_DEM_hires_elv and a PDF created for i_DEM_hires_src

Changed spare7 to spare7 (556)

Added the following new parameters:

i_DEM_hires_src (40)

i_DEM_hires_elv (40)

i_satNdx(40)

i_satRngCorr(40)

i_satCorrFlg(40)

i_satNrgCorr(40)

i_satPwdCorr(40)

i_gval_rcv(40)

i_RecNrgAll(40)

i_FRir_cldtop(40)

i_FRir_qaFlag(40)

i_FRir_ODflg(40)

i_FRir_intsig(40)

i_msRngCorr (40)

i_msCorrFlg (40)

i_Surface_temp

i_Surface_pres

i_Surface_relh

GLA07:

Changed definitions for i1_g_bscs_qf in i_532AttBS_Flag

Changed spare4 to spare4 (130)

Added the following new parameters:

i_Surface_temp

i_Surface_pres

i_Surface_relh

i_Surface_wind

i_Surface_wdir

GLA08:

Changed spare2 to spare2 (264)

Added the following new parameters:

i_SolarAngle (4)

i_Aer_top_b20_temp (5)

i_Aer_top_b20_pres (5)

i_Aer_top_b20_relh (5)

i_Aer_bot_b20_temp (5)

i_Aer_bot_b20_pres (5)

i_Aer_bot_b20_relh (5)

i_Aer_top_a20_temp (3)

i_Aer_top_a20_pres (3)

i_Aer_top_a20_relh (3)

i_Aer_bot_a20_temp (3)

i_Aer_bot_a20_pres (3)

i_Aer_bot_a20_relh (3)

i_Aer_PBL_LR_temp

i_Aer_PBL_LR_pres

i_Aer_PBL_LR_relh

i_Aer_ir_top (2)

i_Aer_ir_bot (2)

i_Aer_ir_layflg (2)

i_Aer_ir_top_temp (2)

i_Aer_ir_top_pres (2)

i_Aer_ir_top_relh (2)

i_Aer_ir_bot_temp (2)

i_Aer_ir_bot_pres (2)

i_Aer_ir_bot_relh (2)

i_Surface_temp (4)

i_Surface_pres (4)

i_Surface_relh (4)

i_Surface_wind (4)

i_Surface_wdir (4)

GLA09:

Changed scaling in id_FRg_grd_sig and d_FRir_grd_sig, from 1.0d-11 to i.0d-9 plus changed prod units from e11/m-sr to e9/m-sr

Changed spare4 to spare4 (590)

Created PDF for i_LRir_QAflag

Added the following new parameters:

i_FRir_cldtop (160)

i_FRir_qaFlag (160)

i_FRir_intsig (160)

i_SolarAngle (4)

i_LRir_cld_top (10)

i_LRir_cld_bot (10)

i_LRir_QAflag (10)

i_LRir_cldtop_temp (10)

i_LRir_cldtop_pres (10)

i_LRir_cldtop_relh (10)

i_LRir_cldbot_temp (10)

i_LRir_cldbot_pres (10)

i_LRir_cldbot_relh (10)

i_MRir_cld_top (10,4)

i_MRir_cld_bot (10,4)

i_MRir_QAflag (10,4)

i_MRir_cldtop_temp (10,4)

i_MRir_cldtop_pres (10,4)

i_MRir_cldtop_relh (10,4)

i_MRir_cldbot_temp (10,4)

i_MRir_cldbot_pres (10,4)

i_MRir_cldbot_relh (10,4)

i_LRg_cldtop_temp (10)

i_LRg_cldtop_pres (10)

i_LRg_cldtop_relh (10)

i_LRg_cldbot_temp (10)

i_LRg_cldbot_pres (10)

i_LRg_cldbot_relh (10)

i_MRg_cldtop_temp (10,4)

i_MRg_cldtop_pres (10,4)

i_MRg_cldtop_relh (10,4)

i_MRg_cldbot_temp (10,4)

i_MRg_cldbot_pres (10,4)

i_MRg_cldbot_relh (10,4)

i_LRg_SourceFt

i_MRg_SourceFt (4)

i_HRg_SourceFt (20)

i_LRir_SourceFt

i_MRir_SourceFt (4)

i_Surface_temp (4)

i_Surface_pres (4)

i_Surface_relh (4)

i_Surface_wind (4)

i_Surface_wdir (4)

GLA10:

Changed spare5 to spare5 (292)

Added the following new parameters:

i_SolarAngle (4)

i_MRg_cldtop_temp (10,4)

i_MRg_cldtop_pres (10,4)

i_MRg_cldtop_relh (10,4)

i_MRg_cldbot_temp (10,4)

i_MRg_cldbot_pres (10,4)

i_MRg_cldbot_relh (10,4)

i_Aer_top_temp (9)

i_Aer_top_pres (9)

i_Aer_top_relh (9)

i_Aer_bot_temp (9)

i_Aer_bot_pres (9)

i_Aer_bot_relh (9)

i_Surface_temp (4)

i_Surface_pres (4)

i_Surface_relh (4)

i_Surface_wind (4)

i_Surface_wdir (4)

GLA11:

Changed record length to 3032.

Created PDF for i_LRir_QAflag and i_MRir_QAflag

Added description values for i_cld1_flag, i_aer4_flag, and i_pbl4_flag

Changed spare3 to spare3 (144)

Added the following new parameters:

i_SolarAngle (4)

i_MRg_cldtop_temp (10,4)

i_MRg_cldtop_pres (10,4)

i_MRg_cldtop_relh (10,4)

i_MRg_cldbot_temp (10,4)

i_MRg_cldbot_pres (10,4)

i_MRg_cldbot_relh (10,4)

i_Aer_top_temp (9)

i_Aer_top_pres (9)

i_Aer_top_relh (9)

i_Aer_bot_temp (9)

i_Aer_bot_pres (9)

i_Aer_bot_relh (9)

i_Aer_ir_top (2)

i_Aer_ir_bot (2)

i_Aer_ir_top_temp (2)

i_Aer_ir_top_pres (2)

i_Aer_ir_top_relh (2)

i_Aer_ir_bot_temp (2)

i_Aer_ir_bot_pres (2)

i_Aer_ir_bot_relh (2)

i_MRir_cld_top (10,4)

i_MRir_cld_bot (10,4)

i_MRir_cldtop_temp (10,4)

i_MRir_cldtop_pres (10,4)

i_MRir_cldtop_relh (10,4)

i_MRir_cldbot_temp (10,4)

i_MRir_cldbot_pres (10,4)

i_MRir_cldbot_relh (10,4)

i_MRir_QAflag (10,4)

i_Aer_PBL_LR_temp

i_Aer_PBL_LR_pres

i_Aer_PBL_LR_relh

i_Surface_temp (4)

i_Surface_pres (4)

i_Surface_relh (4)

i_Surface_wind (4)

i_Surface_wdir (4)

i_Aer_ir_OD (2)

i_cld_ir_OD (10,4)

i_Aer_ir_ODFlg (2)

i_cld_ir_ODFlg (10,4)

i_FRir_ODFlg (160)

i_FRir_qaFlag (160)

i_FRir_cldtop (160)

i_Aer_b20_prop (20,5)

i_PBL_prop (20)

GLA12:

Changed record length to 6600.

Changed the description for i_elvflg and i_SurfRuf_slpQF

Changed definitions for i_CorrStatFlg

Changed spare7 to spare7 (566)

Added the following new parameters:

i_DEM_hires_src (40)

i_DEM_hires_elv (40)

i_satNdx(40)

i_satRngCorr(40)

i_satCorrFlg(40)

i_satNrgCorr(40)

i_satPwdCorr(40)

i_gval_rcv(40)

i_RecNrgAll(40)

i_FRir_cldtop(40)

i_FRir_qaFlag(40)

i_FRir_ODflg(40)

i_FRir_intsig(40)

i_msRngCorr (40)

i_msCorrFlg (40)

i_Surface_temp

i_Surface_pres

i_Surface_relh

GLA13:

Changed record length to 6760.

Changed the description for i_elvflg and i_SurfRuf_slpQF

Changed definitions for i_CorrStatFlg

Changed spare8 to spare8 (566)

Added the following new parameters:

i_DEM_hires_src (40)

i_DEM_hires_elv (40)

i_satNdx(40)

i_satRngCorr(40)

i_satCorrFlg(40)

i_satNrgCorr(40)

i_satPwdCorr(40)

i_gval_rcv(40)

i_RecNrgAll(40)

i_FRir_cldtop(40)

i_FRir_qaFlag(40)

i_FRir_ODflg(40)

i_FRir_intsig(40)

i_msRngCorr (40)

i_msCorrFlg (40)

i_Surface_temp

i_Surface_pres

i_Surface_relh

GLA14:

Changed record length to 10000.

Changed the description for i_elvflg and i_SurfRuf_slpQF

Changed definitions for i_CorrStatFlg

Added i_DEM_hires_src & i_DEM_hires_elv and a PDF created for i_DEM_hires_src

Changed spare7 to spare7 (566)

Added the following new parameters:

i_DEM_hires_src (40)

i_DEM_hires_elv (40)

i_satNdx(40)

i_satRngCorr(40)

i_satCorrFlg(40)

i_satNrgCorr(40)

i_satPwdCorr(40)

i_gval_rcv(40)

i_RecNrgAll(40)

i_FRir_cldtop(40)

i_FRir_qaFlag(40)

i_FRir_ODflg(40)

i_FRir_intsig(40)

i_msRngCorr (40)

i_msCorrFlg (40)

i_Surface_temp

i_Surface_pres

i_Surface_relh

GLA15:

Changed record length to 6280.

Changed the description for i_elvflg and i_SurfRuf_slpQF.

Changed definitions for i_CorrStatFlg

Changed spare7 to spare7 (594)

Added the following new parameters:

i_satNdx(40)

i_satRngCorr(40)

i_satCorrFlg(40)

i_satNrgCorr(40)

i_satPwdCorr(40)

i_gval_rcv(40)

i_RecNrgAll(40)

i_FRir_cldtop(40)

i_FRir_qaFlag(40)

i_FRir_ODflg(40)

i_FRir_intsig(40)

i_msRngCorr (40)

i_msCorrFlg (40)

i_Surface_temp

i_Surface_pres

i_Surface_relh

i_Surface_wind

i_Surface_wdir

Known Problems

More improvements to waveform processing are forthcoming, including better normalization, alternate fitting, and saturation algorithms.

New parameters i_Surface_wind and i_Surface_wdir are not yet filled.

New parameters i_LRg_SourceFt , i_MRg_SourceFt, i_HRg_SourceFt, i_LRir_SourceFt, i_MRir_SourceFt, i_cld_ir_OD, i_Aer_ir_OD, i_Aer_b20_prop, i_PBL_prop, Aer_ir_ODFlg, Cld_ir_ODFlg and FRir_ODFlg are not yet filled.

GLA01%main%i_TxFlg is not always correctly set.

The STRM track files will be improved and updated to V2.

Release Information

The ClearCase label for this release is RELEASE_5.0.

The release date is October 11, 2005.

All internal version numbers have been updated to “V5.0 September 2005". This should be verified during operation by checking the version information in the appropriate ANC06 files.

SDMS Impact

The distribution tarfile is on glasdev.wff.nasa.gov at the following location:

/glasdev1/v5/dist/gsas_V5.0.tar.Z.

ANC Files

New versions of the ANC07, ANC45 and ANC46 data files are required.

Two new file types have been created: ANC51 and ANC52.

ANC52 is a required input for Elevation processing.

ANC51 is a required input for Elevation processing. ANC51 is a multi-file granule. The correct granules must be chosen to match the data which is to be processed. The ANC51 requirement can be overridden by placing a "ELEVATION_PROCESS=E_Supress_SRTM" line in the control file.

Bundle Changes

(See above)

Compilation

All libraries and binaries should be recompiled using the top-level Makefile. IMPORTANT: due to internal changes in the makefiles, SDMS MUST use the command "make runtime" to ensure the software is made without debug flags.

The process for making the libraries and binaries is as follows (NOTE: SDMS ONLY!!)

cd /install_dir/gsas_v5.0

make runtime

make install

Note : developers should not use the above procedure. This procedure is for SDMS only!

Detailed Change Notes

0002128: D_WT_SGM should be changed to D_WT_SGM1 and D_WT_SGM2

The waveform constant D_WT_SGM was be changed to D_WT_SGM1 and D_WT_SGM2 so that the standard and alternate fits can be optimized separately.

0002119: GLA04 IST Boresight scale error

Fixed L1A conversion problem for ist_boreh and ist_borev on GLA04_04.

0002117: Flags not assigned in GLA*scal_mod.f90

Some new flags now have A2P and P2A code in the appropriate GLAxx_scal_mod.f90.

0002113: Saturation range correction not passed through from GLA06 to GLA12-15

Fixed a GSAS 5.0 problem where certain passthrus were not being populated.

0002111: Normalize WF Fits With Peak Amplitude

Added I_NORMTYPE to anc07_0004. When it is set to 0, waveforms are normalized using area, and when it is set to 1, waveforms are normalized using the maximum amplitude of the waveform. Changed D_WT_SGM from 0.001 to 0.03, and D_INTV_MIN1 from 5.0 to 15.0.

0002109: IEEE Overflow in Atmosphere Optical Properties

Corrected IEEE overflow in atmosphere code.

0002108: GLA07 variables in Product Database

Changed the variable ID's of i_Rng2PCProf & i_Rng2CDProf by adding "_Cor" to the variable. No change to the parameters for i_Rng2PCProf_Cor & i_Rng2CDProf_Cor. But added to the description "This variable has a slight correction applied to it."

0002105: Update GSAS scf_prod_reader subroutines to support 5.0 formats

Updated the scf_product_reader subroutines to support the new GSAS 5.0 product formats.

0002103: inconsistent beam co-elev and azimuth

Beam co-elevation and azimuth are calculated using different range values in glas_atm and glas_alt. The precision orbits are not available when the co-elevation and azimuth and elevation are calculated for the atmosphere products, therefore, the reference range is used. This was done by design and is not an error.

0002100: ANC45/46 Need Update for GSAS 5.0

Updated the VersionID to 24 for all anc45 files, and updated the VersionDescription to the following.

GLA01-GLA04

GSAS version 5.0 (see I-SIPS Product Release notes), POD and PAD versions differ, see header and I-SIPS Release Information table.

GLA05-GLA15

GSAS version 5.0 (see I-SIPS Product Release notes about new formats), POD and PAD versions differ, see header and I-SIPS Release Information table.

Created anc46 files for anc51, and anc52.

0002097: Error in CalcSum Corrs Logic

Fixed a small error in the invalid value-avoidance logic of Elev_Support:CalcSumCorrs.

0002091: Change Scale of d_wfFitSDev

Changed scale of d_wfFitSDev and d_sDevFitTr from 0.001 to 0.00001, and added d_maxSDev (=0.3) to anc07_0004.

Changes have been made to the Product Database for GLA05 parameters d_wfFitSDev_1, d_wfFitSDev_2, & d_DevFitTr. Product Max Value changed from 300 to 30000 and Alg Scale changed from 0.001 to 1.0d-5 in all three parameters.

0002090: Update Product Code from Tested Non-vob Code

Updated the product code from code which was modified outside the vob. Code was tested and verified by the atmosphere team. Two files were updated: gla09_flags_mod and gla09_scal_mod.

0002086: Flags in GLA09_alg_mod.f90 Initialized as Invalid

Corrected. Merged in 2090.

0002085: HiRes DEM Crash

Work completed, reviewed. Code with corrections are on branches pr2085 and wpr2085. Runs supporting the elimination of the crash condition are on isipsdb1 under /playground/sfm/glas_alt, in subdirectories crash_wi_tr and crash_wo_tr. Code merged.

0002084: i_MRir_QAflag Error in GLA11_alg_mod.f90

Fixed definition of i_MRir_QAflag.

0002083: i_LRCir_af, i_MRCir_af in GLA09_alg_mod.f90?

The i_LRir_QAflag flag and i_MRir_QAflag constructs have been modified. The only change to the i_LRir_QAflag in GLA09 is that the "af" portion of the flag has been moved to bits 0-3 of byte 5. This connects it with QAflag values, and renders all spares into contiguous storage within that variable. The i_MRir_QAflag has been modified in GLA09 and GLA11 such that it is now represented by an I*1(40) array. The QAflag portion has been stored such that interval 1 is in bytes 40-36, interval 2 in bytes 35-31, interval 3 in bytes 30-26, and interval 4 in bytes 25-21. Each of the 10 layer flags per interval is 4 bits in length as before, such that interval 1 layer 1 is in bits 0-3 and interval 1 layer 2 is in bits 4-7 of byte 40, interval 1 layer 3 is in bits 0-3 and interval 1 layer 4 is in bits 4-7 of byte 39, etc. The 4 "af"

flags (4 bits each) are concatenated with the QAflag storage and are contained in bytes 20-19 starting at bit 0 of byte 20. The remaining bytes 1-18 are maintained as spares. Individual values of the af and QAflag components do not change from previous descriptions.

0002082: Error in GLA08_alg_mod.f90

Changed variables in GLA08_alg_mod.f90.

0002081: Error in GLA05_scal_mod.f90

Corrected the gi_invalid statement from gi_invalid_i4b to gi_invalid_i2b in GLA05_scal_mod.f90. This was in cr2080 and unit tested in the same.

0002080: Unit Test Product Modifications

Used the product unit test code to verify the GSAS 5.0 product modifications. Unit test completed for GLA05 - GLA15.

0002079: Add 40Hz Lidar Cloud Information from GLA09,11 to GLA06/12-15

Added the following atmosphere parameters to GLA06,12-15

GLA09%d_FRir_cldtop

GLA09%i_FRir_qaFlag

GLA09%d_FRir_intsig

GLA11%i_FRir_ODflg

Note that i_FRir_ODflag is not yet computed by a science algorithm and is currently only a placeholder.

0002078: Alternate Fit Anc07 Constant Change

Changed D_WT_SGM.

0002076: i_elvflg and i_SurfRuf_slpQF are Inconsistent between GLA06 and GLA14

Added the following description to the variable i_SurfRuf_slpQF that is in GLA06,12,14. For GLA06 and 12-15, bits are set to reflect Standard Fitting. For GLA14, bits are set to reflect Alternate Fitting. Although defined as a pass-thru, the values are different on GLA06/12-15 and GLA14."

0002075: i_SigmaElv is Incorrect on GLA06

Code was modified such that GLA06 i_SigmaElv is consistently undefined.

0002074: The High Gain Saturation Flag in GLA05%l_WFqual Might not be Set Correctly

Using width of maxPeak instead of last pk for determining high gain saturation for laser 3.

0002062: Undefined cloud layer quality flags in GLA09

The following atmosphere flags are now defined and documented:

i_LRCL_Flag, i_MRCL_Flag, i_HRCL_Flag, i_FRCL_Flag

0002056: Change d_ThrNSigR

Changed d_ThrNSigR in anc07_0001 from 2.0d0 to 4.5d0

0002055: Incomplete Documentation for Lidar Flags

The quality and use flags (i_cld1_flag, i_aer4_flag, and i_pbl4_flag) for GLA11 were properly defined by Mantis 0002029.

0002054: Confirm and Correct Behavior of SRTM Code for Use under SDMS

Software has been modified to electively suppress inclusion of the SRTM high resolution elevations data when creating GLAS elevations products.

0002050: GLA09 Med Res (1 Hz) Quality Flags are Weird

The problem with the medium resolution (1/sec) cloud quality flags was found. There was a coding error in the routine "fpk_MRCL_Flag" that caused the quality flag to be stored in reverse time order as indicated in the documentation. No other medium resolution flags had this problem nor did it affect either the low (1/4 sec), high (5/sec) or full (40/sec) cloud quality flags.

Changed also on the branch was the 532 laser energy lower limit cutoff for daytime processing from 4.0 mJ to 5.5 mJ. This was a hard coded number within AtmMgr_mod.f90 and it was changed so that all of laser 3 532 nm data would not be processed during the day.

0002049: QAPCompare Formatted Out Error

A problem that caused metadata values to overflow the output field and print as a string of asterisks was fixed.

0002048: Coordinate GSAS 5.0 Product Structure Changes

Coordinated the documentation and coding of the GSAS 5.0 product structure changes.

0002045: Error in QAP Headers for Files Written by QAPG

Header records for file start and end date/time were corrected.

0002042: Add Energy and Received Gain to Higher Level Altimeter Products

Added the following parameters to GLA06,12-15

i_satNdx

i_RecNrgAll

i_gval_rcv

i_Surface_temp

i_Surface_pres

i_Surface_relh

0002036: atmQF Flag Not Reset Dynamically

Change was made to atmqf flag as directed. (1=atmqf forward scatting flag has not been set - no valid Atmosphere data available for this shot)

0002034: Waveform Fit Standard Method Location /Convergence Change

Changed standard fit to use a specific value (0.07 ns) for convergence of the location parameter instead of a percentage change (2%).

0002033: Add New Variable to GLA06 and Higher Elevation Products

Verification made that GSAS v5.0 has parameters added in all of the product 6,13,15 prod, scal, and alg modules. What remains is to set these parameters when making an elevation run. This entry was handled under Mantis 2042, and verified.

0002029: GLA11 Quality and Use Flags

Added defined values for the quality and use flags in parameters i_cld1_flag, i_aer4_flag, and i_pbl4_flag of GLA11.

0002027: i_AttFlg1 Incorrectly Defined

On GLA08-11, i_AttFlg1 was changed to be a 2-byte integer, not a 1-byte integer. It now has an array size of 4, instead of a single value.

0002025: Addition of Meteorology Data to GLA08-11

Temperature, atmospheric pressure, and relative humidity have been added to atmospheric products for the various detected cloud and aerosol layers, as well as for the surface conditions. This mantis was also used to resolve a minor flag calculation problem in modules A_1s_1064_det_mod.f90 and A_4s_1064_det_mod.f90.

0002023: Update L1A ATBD

The updates as listed in the Description section of this Mantis item have been made and approved. The GLAS web site has been updated with the latest version of the document.

0002022: GLA09 Data Product Scaling Factor Documentation Error

Changed values for parameters i_FRg_grd_sig & i_FRir_grd_sig in GLA09.

0002021: Error in Calculation of Standard Deviation of Fit

A problem that caused the standard deviation of fit to be calculated incorrectly, and a problem that caused the standard fit to use the anc07 alternate convergence criteria were corrected.

0002019: Update anc45 VersionID 23

Anc45's for GLA06, and GLA12-GLA15 were updated to VersionID 23.

0002015: Old Unused Modules Should be Removed from Waveforms Directory

The src/waveforms directory has been removed. All relevant code has been moved to the src/wf_lib directory.

0002013: QABrowse Error for GLA10

The code was modified to handle GLA10 data with only one valid along-track point. The online documentation was updated.

0001993: WFQual Select Region Flags Descriptions are Unclear

Changed the Product Description for i_WFqual, bits 18 & 19.

0001992: GLA15 Elevation Wrong

Updated GSAS version to 4.3.1. Passed alternate ThresRng to PreGeoLoc for use when no std fit available. Now using Tide corrections for GLA06 elevation. Revised code such that lat/lon/elev are truly invalid values when no valid position is calculated. Put Centroid in GLA14%d_ldRngOff. Reworked ElvuseFlg logic to guarantee flag is set when elev is invalid. Removed Elvuseflg passthru code. Fixed bad comparisons with surf_ruf, solnSigmas, parmTr. Fixed bad comparison when setting GLA15%d_elev. Changed logic such that alt dtrop and std dtrop are evaluated independently. Fixed logic such that alternate geoloc rng used for PreGeoLoc is std unavailable.

0001986: Elevation Correction for Saturation

Added anc5201 (range saturation correction table), anc5202 (energy saturation correction table), and anc5203 (pulse width saturation correction table). anc5201 for gain > 13, and all of anc5202 & anc5203 are set to gi_invalid_i4b. These tables are used to set d_satRngCorr, d_satNrgCorr, d_satPwdCorr, and i_satCorrFlg which have been added to

gla06 and 12-15 (see mantis 2048). i_satCorrFlg indicates the source of the saturation corrections. Bits 7 & 6 for d_satPwdCorr, bits 5 & 4 for d_satNrgCorr, and bits 3 through 0 for d_satRngCorr. The source is listed in the header of each file.

0001985: V4.3 i_CorrStatFlg(3) Definitions need Improvement in Database

Update made to i_CorrStatFlg.

0001980: GLA07 il_g_bscs_qf Definition Needs Updating in Database

Changed definition of i1_g_bscs_qf in GLA07 composite flag: i_532AttBS_Flag. Changed per description.

0001978: Add QAP Version Number Override.

Modules changed.

0001976: Error during Comparison of QAP04 Files

Fixed bug that allowed the code to address a nonexistent component of a structure.

0001971: Received Energy is not being Computed in GSAS 4.3

Added code to convert the standard deviation of noise from counts to volts for the call to C_CalcrNrg. Changed GD_THRNSIGR to 2.0d0. Modified C_CalcrNrg so that if either received energy is zero, then both are set to invalid.

0001946: Incorrect Calculation of QAP04 Metadata Statistics

Calculation of GLA04 metadata corrected.

0001939: Product Record Size Change

Increased product sizes in preparation for GSAS 5.0 parameter additions.

0001932: Modify QAPCompare to generate valid GLA03 metadata

Mantis 1932 updates the IDL QA read, browse, and metadata software to deal with changes to QAP03. anc07_001_01_0005.dat is no longer used. Metadata is now produced for QAP03.

001931: QAP03 Use of Non-science vs Science Limits for Engineering Values

The GLA03 limit-checking constants were updated to reflect science, rather than engineering, limits.

0001868: Incorporate SRTM DEM Data into GSAS Software

Two new parameters have been added to GLAS products 06 and 14 to hold high resolution DEM elevations and a source flag for that data. The parameters are:

i_DEM_hires_src(40) I*1 High resolution source flag

i_DEM_hires_elv(40) I*2 High resolution elevation

The unit of measure for the elevations is in meters. The source flag currently has only two values, such that:

0 = no value available

1 = SRTM data as source

The data used to fill these parameters is derived from the Shuttle Radar Topography Mission (SRTM), which was flown to map the world in three dimensions. One of the data products which resulted from this mission is a digital topographic map of the Earth's land surface with points spaced roughly 3 arc-seconds apart-roughly a resolution of 90 meters in latitude and in longitude. There is an inherent limitation in the data caused by the Shuttle's orbit, such that DEM values are only available between +60 and -60 degrees of latitude. All available SRTM elevations are now added to the specified products during production. Further high resolution elevations may be added from other sources at a later date. The recorded values are corrected for the geoid elevation. The data assignment algorithm uses a weighted average of valid data points based on the 3x3 matrix of elevations sur-

rounding a lat/lon position whenever the nearest point does not contain valid data.

0001839: Noisy WFs have Bad Alternate Fits

I fixed a problem in W_Estimates and that corrected some of the bad fits (see file pr1839_3.ppt), but not all of the bad fits. Bad fits fixed by mantis 0001945. Fixed in mantis 0001945.

0001798: 40 Hz Cloud Heights from the 1064 Channel

The full resolution 40 Hz cloud top heights, qa flag, and integrated signal, all from the 1064 nm data channel, have been added to GLA09 products.

0001005: Modify QAPG to Work with Changed QAP03_mod.

QAPG was modified to produce QAP03 files that duplicate GLAS_L1A produced QAP03 files. Any differences between the QAPG and QAP files are due to storage discretization.

The i_LsrAmp out of bounds variable shows a significant difference between the two files. The l1a i_LsrAmp_out value (101.308) flags the yellow limit because it exceeds the 101 limit value. QAPG does not have the same precision for the variable and does not flag the yellow limit because the QAPG value for the variable is 101.

variable name, L1a value, QAPG value, difference

I_LSRAMP_C_N.NOUTOFLIMITS: 1860 66 -1794 ******

The difference is a result of storage discretization. The 9/26/2003 data used for testing coincided with laser start fire and the instrument had not yet settled causing the yellow limit to be exceeded.

Abbreviations & Acronyms

A2P	Algorithm-to-Product Conversion
ALT	Altimeter or Altimetry, also designation for the EOS-Altimeter spacecraft series
ANCxx	GLAS Ancillary Data Files
APID	GLAS Level-0 Data file
ATBD	Algorithm Theoretical Basis Document
ATM	Atmosphere
CCB	Change Control Board
ClearCase	GSAS version tracking software
CR	Change Request
DAAC	Distributed Active Archive Center
DEM	Digital Elevation Model
DFD	Data Flow Diagram
DLT	Digital Linear Tape
EDOS	EOS Data and Operations System
EDS	Expedited Data Set
ELEV	Elevation
EOC	EOS Operating Center
EOS	NASA Earth Observing System Mission Program
EOSDIS	Earth Observing System Data and Information System
GB	Gigabyte
GDS	GLAS Ground Data System
GLAS	Geoscience Laser Altimeter System instrument or investigation
GLAxx	GLAS Science Data Product Files
GLOP	GLAS Level-0 PGE (correctly called GLAS_L0proc)
GPS	Global Positioning System
GSAS	GLAS Science Algorithm Software
GSFC	NASA Goddard Space Flight Center at Greenbelt, Maryland
GSFC/WFF	NASA Goddard Space Flight Center/Wallops Flight Facility at Wallops Island, Virginia

HDF	Hierarchal Data Format
HDF-EOS	EOS-specific Hierarchal Data Format
I-SIPS	Icesat Science Investigator Led Processing System
I/O	Input/Output
ICESAT	Ice, Cloud and Land Elevation Satellite
ID	Identification
IEEE	Institute for Electronics and Electrical Engineering
ISF	Instrument Support Facility
IST	Instrument Star Tracker
KB	Kilobyte
L0	Level 0
L1A	Level-1A
L1B	Level-1 B
L2	Level-2
LASER	Light Amplification by Stimulated Emission of Radiation
LIDAR	Light Detection and Ranging
LPA	Laser Pointing Array
LRS	Laser Reference System
MB	Megabyte
MET	(context sensitive) Mission Elapsed Time or Meteorological
MOSS	Mission Operations Science Simulation (test)
N/A or NA	Not (/) Applicable
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
P2A	Product-to-Algorithm Conversion
PAD	Precision Attitude Determination
PDF	Portable Document Format
PDS	Production Data Set
PGE	Product Generation Executable
POD	Precision Orbit Determination
PR	Problem Report
QA	Quality Assessment

QAP	Quality Assessment Processing
SC	Structure Chart
SCF	Science Computing Facility
SDMP	Science Data Management Plan
SDMS	Scheduling and Data Management System
SDP	Standard Data Products
SRS	Stellar Reference System
SSMP	Science Software Management Plan
SSRF	Science Software Requirements Document
TBD	to be determined, to be done, or to be developed
UNIX	the operating system jointly developed by the AT&T Bell Laboratories and the University of California-Berkeley System Division
UTC	Universal Time Correlation
WF	Waveform
A2P	Algorithm-to-Product Conversion
ALT	Altimeter or Altimetry, also designation for the EOS-Altimeter spacecraft series
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ATBD	Algorithm Theoretical Basis Document

Glossary

aggregate	A collection, assemblage, or grouping of distinct data parts together to make a whole. It is generally used to indicate the grouping of GLAS data items, arrays, elements, and EOS parameters into a data record. For example, the collection of Level 1B EOS Data Parameters gathered to form a one-second Level 1B data record. It could be used to represent groupings of various GLAS data entities such as data items aggregated as an array, data items and arrays aggregated into a GLAS Data Element, GLAS Data Elements aggregated as an EOS Data Parameter, or EOS Data Parameters aggregated into a Data Product record.
array	An ordered arrangement of homogenous data items that may either be synchronous or asynchronous. An array of data items usually implies the ability to access individual data items or members of the array by an index. An array of GLAS data items might represent the three coordinates of a georeference location, a collection of values at a rate, or a collection of values describing an altimeter waveform.
file	A collection of data stored as records and terminated by a physical or logical end-of-file (EOF) marker. The term usually applies to the collection within a storage device or storage media such as a disk file or a tape file. Loosely employed it is used to indicate a collection of GLAS data records without a standard label. For the Level 1A Data Product, the file would constitute the collection of one-second Level 1A data records generated in the SDPS working storage for a single pass.
header	A text and/or binary label or information record, record set, or block, prefacing a data record, record set, or a file. A header usually contains identifying or descriptive information, and may sometimes be embedded within a record rather than attached as a prefix.
item	Specifically, a data item. A discrete, non-decomposable unit of data, usually a single word or value in a data record, or a single value from a data array. The representation of a single GLAS data value within a data array or a GLAS Data Element.
label	The text and/or binary information records, record set, block, header, or headers prefacing a data file or linked to a data file sufficient to form a labeled data product. A standard label may imply a standard data product. A label may consist of a single header as well as multiple headers and markers depending on the defining authority.
Level 0	The level designation applied to an EOS data product that consists of raw instrument data, recorded at the original resolution, in time order, with any duplicate or redundant data packets removed.
Level 1A	The level designation applied to an EOS data product that consists of reconstructed, unprocessed Level 0 instrument data, recorded at the full resolution with time referenced data records, in time order. The data are annotated with ancillary information including radiometric and geometric calibration coefficients, and georeferencing parameter data (i.e., ephemeris data). The included, computed coefficients and parameter data have not however been applied to correct the Level 0 instrument data contents.

Level 1B	The level designation applied to an EOS data product that consists of Level 1A data that have been radiometrically corrected, processed from raw data into sensor data units, and have been geolocated according to applied georeferencing data.
Level 2	The level designation applied to an EOS data product that consists of derived geophysical data values, recorded at the same resolution, time order, and georeference location as the Level 1A or Level 1B data.
Level 3	The level designation applied to an EOS data product that consists of geophysical data values derived from Level 1 or Level 2 data, recorded at a temporally or spatially resampled resolution.
Level 4	The level designation applied to an EOS data product that consists of data from modeled output or resultant analysis of lower level data that are not directly derived by the GLAS instrument and supplemental sensors.
metadata	The textual information supplied as supplemental, descriptive information to a data product. It may consist of fixed or variable length records of ASCII data describing files, records, parameters, elements, items, formats, etc., that may serve as catalog, data base, keyword/value, header, or label data. This data may be parsable and searchable by some tool or utility program.
orbit	The passage of time and spacecraft travel signifying a complete journey around a celestial or terrestrial body. For GLAS and the EOS ALT-L spacecraft each orbit starts at the time when the spacecraft is on the equator traveling toward the North Pole, continues through the equator crossing as the spacecraft ground track moves toward the South Pole, and terminates when the spacecraft has reached the equator moving northward from the South Polar region.
module	A collection of program statements with four basic attributes: input and output, function, mechanics and internal data.
pass	A sub-segment of an orbit, it may consist of the ascending or descending portion of an orbit (e.g., a descending pass would consist of the ground track segment beginning with the northernmost point of travel through the following southernmost point of travel), or the segment above or below the equator; for GLAS the pass is identified as either the northern or southern hemisphere portion of the ground track on any orbit
product	Specifically, the Data Product or the EOS Data Product. This is implicitly the labeled data product or the data product as produced by software on the SDPS or SCF. A GLAS data product refers to the data file or record collection either prefaced with a product label or standard formatted data label or linked to a product label or standard formatted data label file. Loosely used, it may indicate a single pass file aggregation, or the entire set of product files contained in a data repository.
program	The smallest set of computer instructions that can be executed as a standalone unit
record	A specific organization or aggregate of data items. It represents the collection of EOS Data Parameters within a given time interval, such as a one-second data record. It is the first level decomposition of a product file.
Scenario	A single execution path for a process.

Standard Data Product	Specifically, a GLAS Standard Data Product. It represents an EOS ALT-L/ GLAS Data Product produced on the EOSDIS SDPS for GLAS data product generation or within the GLAS Science Computing Facility using EOS science community approved algorithms. It is routinely produced and is intended to be archived in the EOSDIS data repository for EOS user community-wide access and retrieval.
Subroutine	A program that is called by another program
variable	Usually a reference in a computer program to a storage location, i.e., a place to contain or hold the value of a data item.